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ANNUAL REPORT FOR 1940

Northeastern Forest Experiment Station

New Haven, Conn.

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Forest Service
U. S. Department of Agriculture

NORTHEASTERN FOREST EXPERIMENT STATION
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TABLE OF CONTENTS

Highlights of Research Results for 1940 1

Reorientation of Program 3

Financial History 4

Proposal for "Pilot Plant" Demonstrations . . . 5

Experimental Forests 7

Quaker Work Camp at Cooperstown, New York 8

Advisory Council 9

Silviculture 10

Spruce-Fir 10

Northern Hardwoods 14

White Pine 16

Forest Genetics 18

Heredity and Variation 19

Cytological Aspects 20

Physiological Aspects 20

Practical Application 21

Mensuration 21

Planting 22

Forest Fire Protection 24

Forest Economics 24

Forest Cooperatives 24

Outlets for Farm Forest Products 30

Forest Products 32

Connecticut Farm Forestry Fuelwood Study . . . 33

Flood Control Surveys 35

Forest Insect Investigations 38

Forest Pathological Investigations 40

Forest Wildlife Ralationships 42

Publications 43

Personnel 45

R - NE
REPORTS
Station's Annual

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ANNUAL REPORT

of the

NORTHEASTERN FOREST EXPERIMENT STATION

1940

HIGHLIGHTS OF RESEARCH RESULTS FOR 1940

1. Comparison of operating costs in cutting a 95 acre stand of second-growth spruce and fir revealed that partial cutting was slightly more economical than clear cutting.

2. Tree size, more than any other factor, determines the cost of producing peeled pulpwood from accessible second-growth spruce and fir. A cord of wood from 6" trees costs at least 50% more than the same amount of material cut from 12" trees. Consequently, in conserving immature trees, the land owner not only assures himself of another crop in the not too distant future, but increases his average stumpage realization.

3. Hardwoods tend to supplant and crowd out spruce and fir in the restocking of old-field spruce and fir after clear cutting. Weedings and release cuttings are therefore required to maintain spruce and fir production on such areas.

4. Analyses of losses in the Bartlett Experimental Forest resulting from the 1938 hurricane yielded some significant facts about wind-throw. Losses were heavier in uneven-aged stands with irregular crown canopies than in the more uniform even-aged stands. Stands opened up by partial cuttings were even more susceptible. In mixed even-aged stands the intolerant and rapid-growing hardwoods, white ash, paper birch and red maple suffered heavier losses than the more tolerant and slower growing beech, yellow birch and sugar maple.

5. Forest cover in northern New Hampshire delays soil freezing about one month, and may thus have mitigating effect on late fall floods. Furthermore, formation of snow-like crystals upon freezing enables forest soil to maintain a good degree of permeability far into the winter whereas soils in the open begin to freeze solid early in November.

6. Frost penetration is much less under hardwood stands than under softwoods or in the open. Furthermore, spring thawing is completed earlier in hardwood stands than under other conditions.

7. Cottontail rabbits have definite preference for certain species of hardwoods used in game food plantings. Kentucky coffee tree, honey locust, and catalpa are favored over black locust and hackberry while red mulberry is avoided completely.

8. Food preferences of snow-shoe rabbits should be considered in weeding of very young stands of northern hardwoods. Service berry and striped maple should be retained as buffers to minimize damage to sugar maple. Competition from beech and red maple may be reduced by topping, with the expectation that girdling by rabbits will later eliminate the stems and preclude replacement by sprouts. The birches, pin cherry and balsam fir are almost completely avoided by snow-shoe rabbits.

9. Greenwood cuttings of white pine, a difficult species to propagate vegetatively, can be rooted in outdoor beds up to about 50 percent with proper treatment. Survival of cuttings is unfavorably affected by any form of reduction of leaf area.

10. Hybrid poplars cannot be successfully established on grass land without removing sod and cultivating an area with a radius of at least 1 ft. around each tree. Spacing should be close enough to result in a closed canopy in 2 or 3 years -- probably about 4 x 4 feet.

11. Adoption of Swedish one-man buck saws for both felling and bucking increases the efficiency of producing fuelwood from hardwood trees up to 11" in diameter. Costs are also generally reduced if wood is yarded to a central point in tree lengths.

12. Utilization of low grade hardwood for heating by conversion to wood gas was found by analysis to be economically feasible in Connecticut only if current wood costs could be reduced about $2.00 per cord.

13. "Char-Wood" heaters prove efficient and economical in service but changes in design are needed to overcome mechanical failures and prevent escape of smoke and fly-ash while charging.

14. In the white pine region at the head of Lake Champlain in Essex County, N. Y. 89% of the average of 1282 cu. ft. of wood used annually on the farms is fuelwood. Fuelwood also accounts for one-third of the major forest products sold from the farms. Its sale value of $.08 per cubic foot is equal to that of low grade logs or pulpwood.

15. In Essex County, N. Y. forest products constitute only 7% of the average farm income. More than 90% of the sales of major forest products, which average $106 per farm annually, goes to local markets.

16. Buildings on valley farms in Essex County, N. Y. contain about 62 M bd. ft. of lumber and utilization for maintenance is at the rate of only 1% annually. On hill farms buildings only average 51 M bd. ft. and maintenance is at the still lower rate of less than 400 bd. ft. annually. Of all the lumber used for maintenance of buildings, 84% is new native material, 14% comes from old buildings and only 2% is imported from other regions.

REORIENTATION OF PROGRAM

From time to time in the life of any organization it becomes desirable to review the course of its development and reanalyze the problems it faces in the light of current developments in its economic, social, and political environment. Such a period of stock-taking is almost sure to result in some shifting and clarification of objectives and to indicate the need for some reorientation of program. However, in a field such as forest research where experiments must extend over a long period of years, the analyses must be searching and far reaching in order that the limited funds available may not be dissipated in studies of superficial problems of the moment which may fade into insignificance before results can be achieved. It is important to envision the fundamental trends in the tides affecting forest lands and forest resources in the region and not be too easily swayed by passing fads or the emotional stresses of periods of unrest. Perhaps no service is more important to the nation even in times like the present than that of developing a sound scientific basis for the conservation and efficient management of the land and its productive resources. To achieve the continuity of effort so essential for this objective calls for clear vision in planning supported by perseverance in action.

Faced with successive reductions in allotments following a period in which it had been called upon to greatly widen the scope of its activities, the Northeastern Forest Experiment Station found it necessary to re-examine its program during 1940 in the comprehensive manner suggested above. Such a stock-taking had, in fact, been under way since the destruction of much of the Station's long-term experiments by the hurricane of 1938.

Financial History

A review of the financial history of the Station, shown graphically in Figure 1, will afford some background for clear understanding of the current situation.

The Northeastern Station was established in the fiscal year 1924, with an allotment of $22,500 which, with some small increases in succeeding years, was devoted to the silviculture of spruce and fir, mensuration (also with respect to spruce and fir), and forest-fire research. In F. Y. 1932, an increase of $18,000 was provided for work on forest planting and growth yield and management of northern hardwoods. In F. Y. 1934, the Station bore its share of an over-all "economy" cut of 25 percent, but this was offset the next year by C.C.C. allotments. C.C.C. allotments exceeded $15,000 for four years but have subsequently been reduced to a small amount which is used entirely for part time financing of resident superintendents on some of the experimental forests where supervision of C.C.C. work projects requires special technical assistance.

Allotments for Forest Economics commenced in F. Y. 1936 when the forest cooperative project at Cooperstown, N. Y. was initiated. In the same year the Forest Insurance project came to the Northeast. It was terminated early in F. Y. 1939.

In F. Y. 1937 the Forest Genetics project was set up with an allotment of $22,500 and a small increase was provided for work in soil fauna. The latter was terminated by the death of Dr. Jacot in 1939. A further increase in forest management funds for work on white pine was obtained in F. Y. 1939, but this was promptly offset by significant cuts for the last 2 years. The impact of these cuts was in turn softened by a special allotment for rehabilitation of experimental areas damaged by the 1938 hurricane.

Small allotments for farm forestry projects in Connecticut and New York dealing with utilization and markets expanded the range of activity somewhat in F. Y. 1940.

While the scope of the work has thus been broadened in the past eight years, the established program has been by no means static. On the contrary, emphasis on various projects has changed significantly during the course of the years. In the early years of the Station's history, mensuration absorbed almost 50 percent of the total, but it has subsequently been reduced to a small service actively. Fire research reached a dominant position a few years after the station was established, but was then tapered off and is now terminated. The allotments for management of spruce and fir increased fairly regularly until the current year, but the relative importance of this project has declined as work in other fields was added to the program. Since 1935, the trend has been to emphasize economics and utilization.

Figure 1

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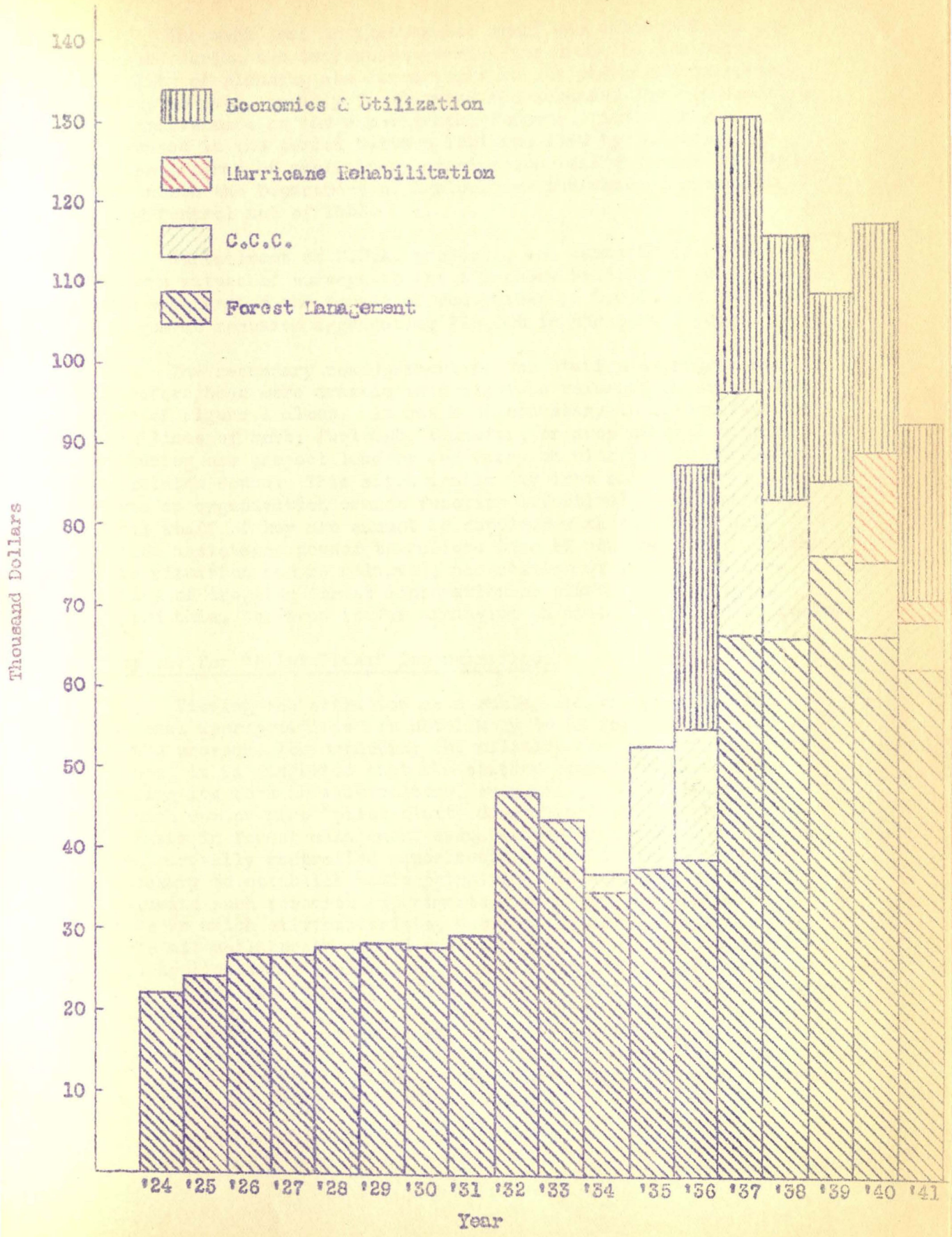


The work load on the station staff was substantially increased during the depression years after 1933, by the responsibility of planning and directing work for unemployment relief, which, however, greatly facilitated and advanced the construction of improvements on the experimental forests. Activity was also increased in the period between 1937 and 1940 by participation in the program of preliminary examinations and watershed surveys with which the Department of Agriculture was charged under the Flood Control Act of 1936.

Curtailment of W.P.A. projects, and transfer of northeastern watershed surveys to the Allegheny Station in July 1940, have exaggerated the impact of reductions in C.C.C. and Forest Management research aggregating $28,000 in the past 3 years.

The necessary readjustment of the Station's program has therefore been more drastic than might be inferred by consideration of Figure 1 alone. It has been necessary to discontinue certain lines of work; furlough, transfer, or drop several people, including one project leader; and carry on with little more than a skeleton force. This situation is far from satisfactory, because an organization cannot function effectively when the technical staff of key men cannot be supplied with the field and office assistance needed to relieve them of routine work. Unless this situation can be relieved, the station will face the necessity of dropping forest mensuration or planting altogether. Beyond this, the need is for expansion in utilization and economics.

Proposal for "Pilot Plant" Demonstrations

Viewing the situation as a whole, and recognizing that additional appropriations are not likely to be forthcoming so long as the pressure for expanding the military and naval forces continues, it is suggested that the station look forward to integrating its work in silviculture, economics, and utilization, through one or more "pilot plant" demonstrations. In the past, emphasis in forest management research has been placed on intensive carefully controlled experiments on small plots. These are necessary to establish basic principles and working hypotheses. Following such research experimental operation on a commercial scale in which silviculturists, economists, and utilization experts all collaborate should pave the way for widespread commercial application. Such pilot plant demonstrations are needed to work out the many complex relationships in improved forest management in a convincing and practical way. They would provide a focus or setting for much of the urgently needed forest products research to which more specific attention is called in a later section of this report. The studies which might be incorporated in such "pilot plant" operations include:

(a) Improvement of equipment and methods to reduce cost of delivering raw material to the conversion plant.

(b) Reduction of cost of construction and maintenance of logging improvements.

(c) Adaptation of logging methods and organization of operations to selective cutting.

(d) Determination of optimum growing stock under selective cutting.

(e) Ecological and economic results of different intensities of cutting and different methods of logging.

(f) Utilization of useful material in trees now considered worthless.

Such integrated pilot plant projects might well be considered for three typical situations in the northeast, namely (1) Spruce and fir in the northern forest, (2) the white pine region, and (3) the northern hardwood farm woodlands of New York.

For spruce and fir and for the white pine types the background of desirable silviculture has been fairly well established. We are, therefore, ready for demonstration and study of the economic application of the established principles.

In the spruce-fir region the opportunity for results from a pilot plant project lies in inducing large owners to differentiate between their holdings in order to set up intensive working circles for the more accessible areas. Obviously, forest practice must remain extensive and simple for the relatively inaccessible wild lands, and the organization of logging operations must be controlled by this fact. However, the adaptation of logging methods to facilitate intensive silvicultural practice offers a big field on the more accessible areas. A project in the northern forest would doubtless involve integration of problems of the spruce and fir with those of northern hardwoods, since the types are intermingled. It may be possible to locate a watershed on National Forest land suitable for such a project, but it is more likely that cooperation with some industrial operation will be necessary. Indeed, operation on private land may involve fewer complications and greater latitude in use of equipment and labor.

For the pine region the need is for integrated management of small holdings. The emphasis would doubtless be on determination and development of optimum growing stock and on the management of mixed stands for improvement in both quantity and quality of production. In this region methods of logging present only minor problems. The northern unit of the Massabesic Experimental

Forest, where land in federal ownership or under option aggregates about 1,700 acres, offers an excellent location. The service of an adjacent C.C.C. camp could doubtless be made largely available for road construction and other improvements needed for such a project on the Massabesic Forest. It is also likely that cooperation of a number of progressive operators owning land in the vicinity could be enlisted.

For the farm woodlands of New York the forest cooperative project at Cooperstown is already serving many of the objectives of the pilot plant experiment. Records of marking and selective cutting have been obtained on several hundred farms. The cooperative association has its own processing plant and is endeavoring to develop economical outlets for a wide range of products. There is need for collaboration from the forest management staff and for aid in the utilization field in developing equipment and techniques to facilitate the handling of a large number of small logging operations scattered over an entire county.

These possibilities were thoroughly discussed with the Northeastern Forest Research Council and it was suggested that first priority should be given to development of a pilot plant in the northern forest. It will not be possible to inaugurate such a project at once. During the course of the coming year, an effort will be made to locate a suitable area and make the necessary cooperative arrangements. Beyond this, work now in progress will be rounded up so as to release some of the time of the forest management staff for developing detailed plans during the ensuing year. Transition to the new objective will thus involve perhaps three years.

Since it will not be feasible to set up an effective "pilot-plant" operation in the spruce region without additional funds, it may be possible to strengthen the effort dealing with farm woodlands at Cooperstown in the interim.

EXPERIMENTAL FORESTS

The spruce and fir stands of the Gale River Experimental Forest in New Hampshire were very seriously depleted by the hurricane of 1938. Almost all the accessible windthrown timber has now been salvaged by commercial sale and a new inventory of the forest growing stock has been completed.

At the Bartlett Experimental Forest, hurricane damage to the prevalent hardwood stands was not so great. Here too, the entire area has been recruised, but it was not possible to salvage any of the timber in the areas of heaviest damage which lay on the higher slopes of the mountain. All the experimental plots have, of course, been cleaned up.

Steps to block out and extend the area of the Massabesic Experimental Forest in Maine were taken by obtaining options on 17 tracts aggregating 1242 acres. Survey and title examination work on these lands is well along and it is hoped that purchase may be consummated during the year ahead. About half the strength of the state C.C.C. camp at Alfred has been devoted to the development of the experimental forest.

No progress was made with the proposal to extend the area of the Hopkins Memorial Experimental Forest in Massachusetts through purchase by the S.C.S. under the Land Retirement Program. The proposal was approved by the local land use planning committee and endorsed by the State Rural Policy Committee. However, previous commitments elsewhere, left no money available for this purpose. A C.C.C. side camp of 45 men was maintained on the Hopkins Forest from April to November.

Because of curtailment of C.C.C. allotments it is no longer possible to maintain a man at the Chenango Experimental Forest throughout the field season. However, C.C.C. crews will doubtless be available for a limited amount of work there. The state C.C.C. camp at Newcomb, N. Y. continues to devote some of its time to silvicultural operations and construction of truck trails on the Finch Pruyn Experimental Forest, although the Station is unable to assign a man there regularly.

QUAKER WORK CAMP AT COOPERSTOWN, NEW YORK

For several years the American Friends Service Committee has operated a number of summer work camps for serious-minded young men and women who desire to obtain first-hand knowledge of significant social or economic problems and at the same time, by their own work, make some tangible contribution to the community with which they are concerned. During the summer of 1940 one of these Quaker work camps was located at Cooperstown, N. Y. for the purpose of cooperating with the Northeastern Station and the Otsego Forest Products Cooperative Association. About 20 men and women, mostly graduate students from various universities, donated 7 hours a day for 8 weeks to manual labor for the Association or the Cooperative. They took turns on the cruising and marking of farm woodlands with our men and constructed a shed for storage of small-dimension stock on kiln tracks for the Association. Throughout the season study was given to local social conditions, problems of agricultural readjustment and the contribution which cooperative forest management might make to rural welfare. Work camps of this sort afford a significant new channel for public education in specific phases of the national forestry program.

In October, the Cooperstown camp was continued on a year-long basis as the first unit in the plans of the American Friends Service committee to handle Civilian Public Service authorized

under the Selective Service Act for those who have conscientious objection to military service. Although a large part of the work program of this year-long camp has been on state reforestation areas for the New York Conservation Department, assistance for farm woodland cruising and marking, and for conducting production cost analyses is still available to the Forest Experiment Station and some work has been done for the cooperative association.

ADVISORY COUNCIL

During the past year 9 new members have been added to the Northeastern Forest Research Advisory Council, bringing the number up to 26 in all. The Council met in New Haven in December and gave consideration to the reorientation of the Station's program which is treated in some detail elsewhere in this report. Following a practice which has proven useful to the conference of directors of northeastern experiment stations, the Council designated certain of its members to serve as "referees" in a number of fields of forest research. These referees are expected to follow developments in their respective fields and keep the Council informed on matters which merit attention or call for action. The appointments are as follows:

Forest Planting	W. G. Howard
Forest Protection	R. E. Rendall
Spruce and Northern Hardwood Silviculture	Perry Merrill
White Pine and Oak Silviculture	S. J. Record
Forest Genetics	W. L. Slate
Forest Economics	J. D. Black
Products and Utilization	S. N. Spring
Forest Influences	R. S. Hosmer

SILVICULTURE

During the past year the station has made comprehensive analyses of regional problems in each of the three major forest types in which it is conducting silvicultural research. These analyses have served to point up thinking and clarify objectives in connection with over-all reorientation of the station's program. They have been developed in consultation with workers from other interested agencies and reviewed by the Northeastern Forest Research Council. The highlights of these problem analyses given in the following pages indicate the direction in which our silvicultural research is headed.

Spruce-Fir

The extensive spruce fir forests of northeastern United States represent a tremendous source of wealth. The pulp and paper industry with its large capital investment has been built around that resource. The prosperity of the region and indeed the continued existence of the pulp and paper mills depends upon a steady and continued supply of pulpwood.

The annual cut of spruce and fir in the Northeast is at a level between 1 1/2 and 2 million cords at present. Less than one-eighth of the production is converted into lumber, the balance going to the pulp mills. The present cut of pulpwood fails to meet consumption needs by approximately 20%. Imports from Canada, Newfoundland and northern European countries supply the deficit of some 435,000 cords. Even at the present level, consumption is not up to the capacity of mechanical and sulphite mills in the region which exceeds the annual pulpwood cut by 1,400,000 cords. Considering the economic and social benefits which accrue, there is every reason for maintaining a permanent domestic supply of home grown timber to meet all future requirements. Thus, in order to provide a sound basis for ultimate sustained yield management and to contribute to the prosperity and stability of dependent communities, it is the purpose of spruce-fir silvicultural research to determine the most economical and efficient methods of restoring and maintaining the productivity of spruce-fir lands. This broad objective can only be realized through integrated effort in the fields of silviculture, economics, and forest products utilization, entomology, and forest pathology.

In extending forest management to the 12 million acres comprising the spruce-fir region, economic factors in a large measure will determine the intensity of silvicultural practice justified. Because of remoteness from market, poor transportation development, low potential productivity, character of timber, etc., only extensive forestry, involving fire protection plus simple, inexpensive silvicultural measures, will be justified

for certain portions of the region. The relatively heavy cutting which will doubtless prevail under such extensive management implies a period of at least 60 years between successive cuts on the same area. During this longer cutting cycle, much of the shorter-lived, more rapid growing balsam fir reaches maturity and succumbs to rot and windfall before timber is produced in sufficient volume to warrant a second commercial cut.

On the other hand, productive lands close to market justify intensive forestry practice. There appears to be ample incentive for large owners, especially the pulp companies, dependent upon their lands for raw material supply, to classify their holdings according to accessibility, and set up management plans which would recognize the possibility of operating the more accessible areas on a much more intensive silvicultural level than is practical for the less accessible areas. Working on a short cutting cycle and combining a selective system of cutting with intensive protection against fire, insects, and disease, it should be possible to harvest practically the entire volume of wood grown on the accessible areas. The practicability of such a scheme of management merits full exploration.

There is reason to believe that with the flow of general construction lumber from the west diminishing, as seems likely in the next few decades, the demand for eastern softwood lumber will again assume large proportions. The forests of the spruce-fir region, if properly managed, not only can supply all prospective requirements of the local pulp mills, but also may support a substantial rejuvenated lumber industry. With this in mind, forest management in the spruce region may well aim to produce good quality saw-logs as well as an abundant supply of pulpwood. It is quite possible that in many sections the largest return will be obtained if sawtimber is the major object of management, with pulpwood being produced simultaneously from tops of sawtimber trees and from thinnings and improvement cuttings designed to keep the stands at optimum growth. Pulpwood operators may well consider whether the average cost of their wood may be reduced by profits obtained from sale of high quality sawlogs cut from the better trees. Research should be directed toward the problems of such integration of pulpwood and sawtimber production, which would involve light but frequent cutting of many-aged stands and might require substantial modification of current operating practices.

Early cutting in the region was generally selective in character since operations were largely confined to removal of the larger sized spruce and pine. As stumpage values increased and utilization became closer, it was

possible to go over areas previously logged for a second or even a third cut. For the past 25 or 30 years, since cutting and driving of 4-foot wood for pulp has so largely displaced the cutting of long logs, most operators have been removing practically all spruce and fir from the land, leaving little above 5" in diameter.

Overcutting for pulpwood, though not leading to extensive forest devastation, unless followed by severe fire, has resulted in greatly reduced and deteriorated growing stock. Fortunately the bulk of the area at time of cutting supported advance conifer reproduction, much of which is developing into fairly satisfactory stands of pulpwood. In the absence of advance reproduction, however, low value hardwoods take possession of the land. Damage to young growth through careless logging, smothering of reproduction under dense slash accumulation following clear-cutting, suppression from competing hardwoods, and fire over extensive areas, have all contributed materially to spruce-fir stand deterioration. Cutting of spruce and fir in mixture with hardwoods, the latter not being utilized, has left extensive areas in possession of frequently worthless stands of overmature hardwood with no prospect of significant softwood growth for the future.

Since practically the entire commercial spruce area has been logged at least once and a large part of it within the last 40 years, silvicultural research in this type should be concerned more with second growth or heavily culled stands rather than with virgin or only lightly culled stands.

During the past 17 years the Northeastern Forest Experiment Station has accumulated a substantial fund of knowledge concerning the management of spruce and fir. Although most of the long-term experiments destroyed by the hurricane of 1938 should be replaced, attention in the future should be directed more and more to fundamental research to explain the "why" of facts uncovered to date. Basic studies in the field of silvics and tree physiology are particularly needed. Meanwhile, as explained in an earlier section of this report, there is need to test and apply the principles now established in large scale demonstrations. The current research program includes 4 phases:

1. Regeneration measures. Extensive surveys have shown that spruce and fir reproduction is normally plentiful on cut-over lands in the spruce types, but where advanced reproduction is not present before cutting, or where invading brush or hardwood growth compete, serious problems arise. Preliminary studies indicate that regeneration of even-aged pure spruce-fir stands devoid of reproduction may be accomplished by partial cuttings in which about one-third of the volume is removed.

Where strong admixtures of hardwoods are found, advance conifer reproduction is frequently lacking. The time element in cutting, girdling of hardwoods in advance of harvesting and other measures to encourage softwood reproduction have been the subject of study for some years but many plots must be replaced as a result of the hurricane.

Studies of seed-bed condition with respect to germination, survival, and growth have been under way for over 10 years. Analyses of the data now being made should result in publication within the next year.

2. Causes and control of stand deterioration. One of the most crucial problems in spruce-fir management is that of conserving the advance reproduction of spruce and fir, which is generally sufficiently abundant at time of cutting to provide a satisfactory stand at maturity. On clear-cut areas brushy growth and myriads of hardwoods of both desirable and undesirable species take possession of the area within a few years. These hardwoods, particularly on the weak softwood sites, make rapid height growth, and soon overtop the slower growing spruce and fir. Under these conditions, spruce and fir are crowded out or forced to assume subordinate positions in the stand. This results in reduction in stocking and conversion of extensive areas of former spruce-producing lands into practically pure hardwoods.

As already mentioned, dense accumulations of slash, damage in logging, fire, wind, insects, and disease are other factors operating to reduce stocking and contribute to stand deterioriation. Thus, there is need for continuing research to determine the conditions under which these factors become critical and to develop cultural techniques which will halt further deterioration and restore productivity where the process is already well advanced.

3. Cutting practices in various spruce-types. The need for cultural measures to assure satisfactory development of advance reproduction on cut-over areas is an indication of failure to properly correlate cutting practices with silvicultural requirements. Methods of cutting must be evolved which will insure normal development of advance reproduction where it exists, stimulate adequate restocking on stands lacking in reproduction and at the same time create favorable conditions for growth of the residual stands. Methods of cutting studies thus far indicate that some form of partial cutting will generally attain these objectives. Among specific problems for study in this connection are methods of converting even-aged stands to all-aged stands as the basis for future selection cutting, methods of cutting and operating aimed at integration of saw-log and pulpwood production, effect of method of cutting on wildlife

and recreational values and relative returns of different methods of cutting. The station has made considerable progress with some of these problems but the hurricane raised havoc with the principal experimental areas.

4. Increasing the growth rate and quality of spruce-fir stands. Spruce-fir lands are growing at scarcely a third their capacity. Thinnings in second-growth pure conifer and mixed spruce-hardwood stands, girdling to release cuttings to increase representation and growth rate of spruce, pruning, swamp drainage -- all are or were being studied. The hurricane destroyed most of the thinning plots, and the bulk of the pruned series. As new experiments in this field are undertaken special attention should be given to methods of reducing the cost of silvicultural operations.

Another significant aspect of this problem is the extent to which annual yield per acre may be increased in both quantity and quality by light but frequent cuttings in many-aged stands where substantial growing stock is built up and maintained. Operators have long contended that such cuttings are impractical and that logging costs would be excessive. The crux of the problem appears to be in the availability of suitable avenues of transportation. Changes in methods and equipment used in logging may be part of the solution.

Northern Hardwoods

The northern hardwoods forest type is one of the most important in the Northeast, occupying more than a quarter of the forest land. A large proportion of the merchantable forest is in private holdings where "creaming" is usually practiced. Ordinarily the lands have not been stripped in lumbering operations, as in softwood stands; nevertheless the quality of the residual stand has declined as a result of repeated cullings in which standards of merchantability have declined with each successive cut.

Even when burned or otherwise abused, northern hardwood lands usually restock to some type of tree growth in which commercially valuable species are well represented. Thus, clearcutting of northern hardwoods cannot be silviculturally condemned per se. But all too frequently the even-aged stands resulting are stripped again as soon as they reach cordwood size. Under repeated clear-cutting the stands deteriorate in composition and quality.

Hardwood logging operations are as a rule extremely wasteful as frequently only high quality trees are cut. Residual trees left after "commercial selection" cutting constitute a serious obstacle to the development of a new crop on thousands of acres.

By-products of saw-timber operations, thinnings and improvement cuttings could readily meet almost any demand for low-grade material. Yet, except on farm woodlands, economic conditions are rarely conducive to the salvage of small or low-grade material after logs have been removed. The present demand for such products as fuel, pulp or distillation wood is largely met by stripping immature, even-aged second growth.

The problem of northern hardwood management, therefore, appears to be primarily economic. The crux of it appears to be in the integration of the use of valuable and less favored species, of high quality and low grade material, and in expanding the markets for the latter. All things considered the potential demand for high-grade hardwoods coupled with increasing use of low-grade material for chemical conversion should provide an incentive for sound forest management in the northern hardwood region wherever adequate transportation is available or can be developed.

Because the many species occurring in the northern hardwood forest cover a wide range in utility, commercial value, and growth characteristics, the silvicultural aspects of forest management are particularly complex. To properly appraise the effects of various silvicultural methods or of the selective cutting of certain species, it is necessary to understand thoroughly the silvical characteristics of all the species involved, especially those relating to production of seed, establishment of reproduction, and response to competition.

In conjunction with a well-rounded silvicultural investigative program, additional knowledge would be essential in several closely associated fields.

Nectria canker, as it affects the silviculture of yellow birch, is only one of many tree diseases that are important problems requiring the joint attention of forest pathologists and silviculturists. Beech scale, sugar maple borer, and bronze birch borer are but three of the numerous insect pests, each attacking one of the important northern hardwood species. Thorough investigations of these three insects, now in progress, will undoubtedly affect the practical application of the results of silvicultural research.

Wildlife management investigations comprise another field necessarily tied into silvicultural management if these two important uses of the forest are to be properly integrated.

That little research on northern hardwoods has been done in the past is evident from the literature on the subject. In the five years, 1935-39 inclusive, as much work was published as in the previous 21 years and this was little enough. So far no

well developed program of research for northern hardwoods exists, although fragmentary work by various agencies is gradually building up a fund of information.

The Northeastern Forest Experiment Station is directing its effort primarily at studies of selective cutting as a means of sustaining local production and of improving quality of the growing stock. This has followed study of factors affecting decadence of yellow and paper birch left after partial cuttings or exposed by heavy thinning. Attention is also being directed toward thinning and weeding. Thus far, the silvicultural work has been largely concentrated on the Bartlett Experimental Forest in New Hampshire, with a very limited program in the Green Mountains and the Adirondacks. Yield studies are being carried forward by observation of plots distributed widely through the region.

The Station's program should eventually include the economic phases of the hardwoods problem. The silvicultural phases are contributing incidentally to this field as time studies and cost data are a logical part of such silvicultural investigations as weeding, thinning, mowing, and partial cutting. Production costs in connection with various harvest and improvement operations deserve major emphasis as they show comparative net returns from different types of harvest cuttings under given conditions. But information of this type cannot lead to definite conclusions as to best methods until plot layouts have been remeasured over periods of years to determine silvicultural results.

The large job of establishing the groups of experimental plots essential to a well rounded program should be completed in a few years. Then a breakdown of the complicated silvical relations of the several species into component parts for short-term investigations to get at causes should be attempted. However, financial limitations preclude more than a modest program at present.

White Pine

In the white pine type, exploitation over a long period of years has been so intensive that valuable stands have been replaced by brush over large areas and the residual second growth contains little merchantable material above box grades. The early "selective cuttings" were followed by later indiscriminate clear cutting and, with the premature cutting of second growth stands, large areas especially on the heavier soils reverted to hardwoods. As these have developed pine has often made its appearance again as an understory. Much of the area is now covered with mixtures of pine and hardwoods of varying ages and

marketability. The hurricane of 1938 wrought its heaviest damage in the white pine region of eastern Massachusetts and southern New Hampshire. In the zone affected most of the pine stands over 40 years of age blew down. Preliminary information indicates that much of the area devastated by the hurricane is not reproducing satisfactorily and will require planting if it is to again be restored to productive condition. The results of the hurricane need further study to decide what changes in emphasis in our research program may be indicated.

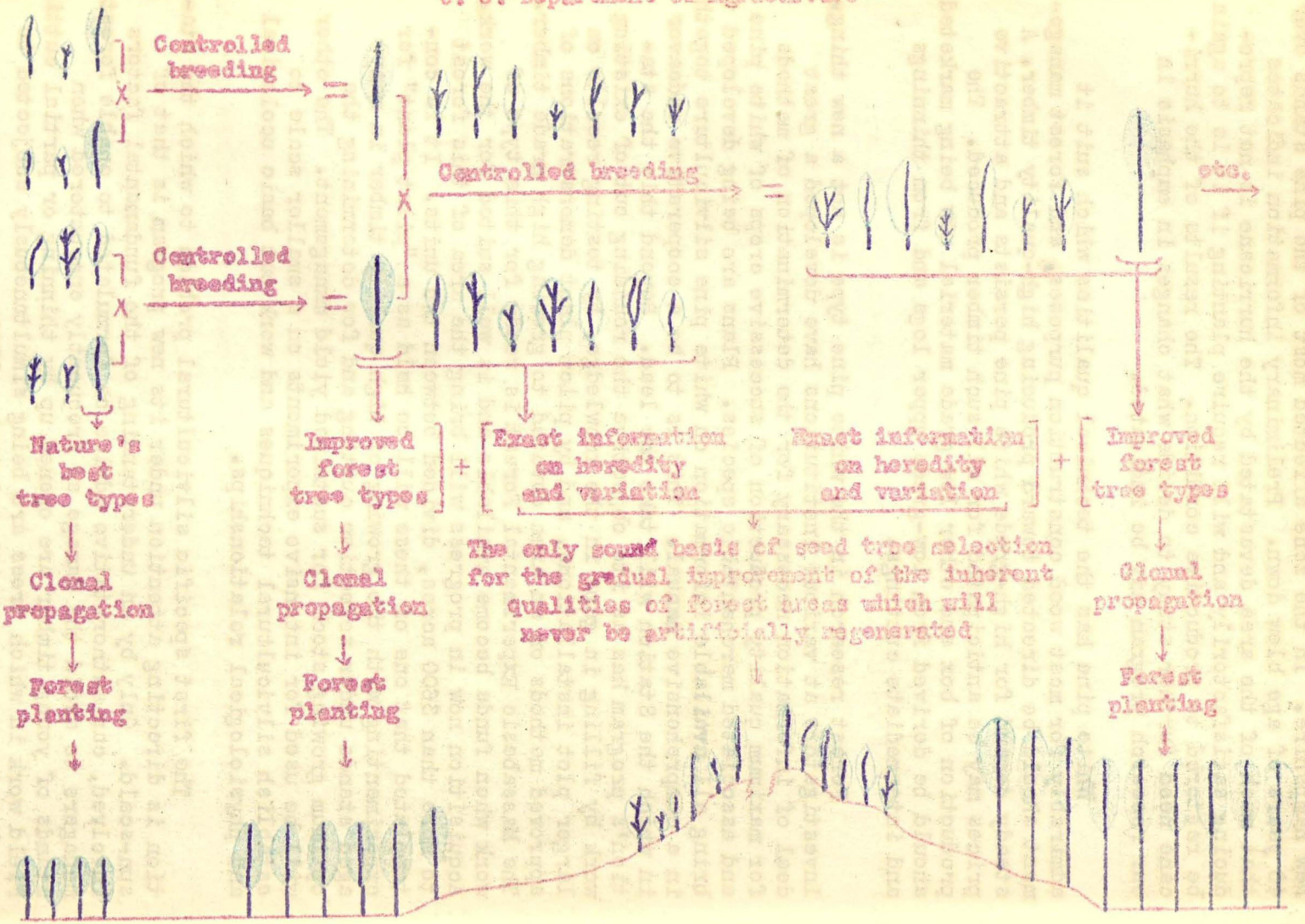
White pine has the technical qualities which suit it admirably for most wood construction purposes, and forest management should be directed toward producing high-quality timber. A steady demand for high-grade white pine persists and attractive prices may be anticipated for all such timber produced. The production of box and other low grade material now being marketed should be derived from low-grade upper logs and from thinnings and intermediate cuttings.

Forest research in the white pine type is not a new thing. Investigators at various institutions have developed a great deal of information necessary for the determination of methods for maximum quality production of successive crops of white pine and associated merchantable species. Plans are being developed to bring all available information on white pine silviculture together in a comprehensive manual. This is to be a cooperative endeavor in which the Station will take the lead. Beyond this the station's program has as its objective the rounding out of existing work by filling in gaps in the knowledge, by testing results on larger plot installations, and by pilot plant demonstrations of approved methods on an area devoted to growing high grade timber. The Massabesic Experimental Forest is ready for this type of work when funds become available and is well suited for the work. Acquisition now in progress will bring the area of this forest to more than 3600 acres, divided between two units. It is contemplated that one of these will be held as a "pilot plant" for experimenting with the growing of high quality timber in many-aged stands under selective cutting and for determining the optimum growing stock for sustained yield management. The other will be used for intensive experiments on a smaller scale to establish silvicultural techniques and work out basic ecological and physiological relationships.

The first specific silvicultural problem to which the station is directing attention under its new program is that of sun-scald. Only by an understanding of the fundamental factors involved, can authoritative advice be formulated to enable forest managers to avoid the damage so frequently encountered when stands of young timber are opened up by thinning or partial cutting. Field work in which trees are being simultaneously subjected to varying exposure was initiated during 1940.

OBJECTIVE
FOREST GENETICS PROJECT

Northeastern Forest Experiment Station
U. S. Department of Agriculture


Controlled breeding
Controlled breeding
Controlled breeding
etc.
Nature's best tree types
Improved forest tree types
Exact information on heredity and variation
Exact information on heredity and variation
Improved forest tree types
The only sound basis of seed tree selection for the gradual improvement of the inherent qualities of forest trees which will never be artificially regenerated
Clonal propagation
Forest planting
Clonal propagation
Forest planting
Clonal propagation
Forest planting

Other problems which have high priority for study include reproduction on "blow-down" areas, development of a tree quality classification, occurrence of ribes as affected by silvicultural practice (in cooperation with the Office of Blister Rust Control), silvicultural control of gypsy moth, (in cooperation with the Division of Forest Insects) relation of silvicultural practice to wildlife (in cooperation with Fish and Wildlife Service) and demonstrations of weeding, thinning, pruning, and harvest cuttings.

FOREST GENETICS

In the project analysis prepared some years ago the objective of the Forest Genetics Project was defined as follows:

> "The development of superior forest tree types adaptable to a wide range of environmental conditions and capable of producing a diversity of high quality products in the shortest possible time, and analagous improvement of the inherent quality of natural forest stands by the application of knowledge derived from genetical research."

This objective is pictured in the chart facing this page. Starting at the left, the project is concerned with the discovery and selection of nature's best forest tree types for immediate use in reforestation (as clones) and as parents for controlled breeding. The objective of controlled breeding is again two-fold:

1. Individual seedlings derived from the breeding work which show improvement in either forest or use characteristics may be selected and used immediately for forest planting if clonal propagation is possible.

2. The seedlings derived from controlled breeding provide the material for determining the mode of inheritance of any characteristic.

Exact information on heredity and variation obtained through such studies, is the only sound basis for seed tree selection for gradual improvement of the inherent qualities of forest stands which will never be artificially regenerated. Although improved forest tree types usable as clones may be considered for artificial restocking, nevertheless there will always be vast areas in the Northeastern region on which mass selection will be the most practical method for genetical improvement.

The work of the genetics project can best be discussed under the four headings which follow.

Heredity and Variation

Thus far in the breeding work major emphasis has been placed on inter-specific cross pollination and on studies to determine the degree of self-fertility in important forest tree species. Crosses between individuals of the same species are also included to determine mode of inheritance and to indicate the adequacy of the breeding technique.

During 1940 seed was obtained from controlled self-fertilization, intra-specific and inter-specific pollinations on species of Acer, Betula, Fagus, Picea and Pinus. In addition self pdlinations were made on Liquidambar styraciflua, Liriodendron tulipifera, Tsuga canadansis, Ulmus americana and three species of Tilia. Good germination of the elm seed obtained indicates that the species is highly self-fertile. On the other hand, red gum appears to be self-sterile since only six small and apparently empty seeds were formed. Similarly self-pollinated seed of red maple did not germinate at all and silver maple yielded only a few seedlings. Determination of self-compatability in the other genera must await testing of the seeds during the 1941 season.

The question of individual variation is one which must be dealt with in respect to selected characteristics which are of commercial or technical interest. Thus far, the station's work in this field has been limited to preliminary study of the variation in sugar content of the sap of Acer saccharum. Individual trees on the Hopkins Memorial Experimental Forest vary from 1% to somewhat higher than 4% sugar in the sap. The run of sap during the 1940 season was so poor that little new data could be obtained. Tapping in 1941 of the trees previously studied will indicate the extent of variation in the same individual trees from year to year, and should permit selection of the high-producers.

Study of racial variation, which will be undertaken on a limited scale as seed of important species of known origin or stock of special significance becomes available, has been initiated by comparison of stock of red and white pine grown from seed collected in Ontario in 1938 with stock from native seed, and by participation in a cooperative test of 14 lots of Norway spruce seed sponsored by the International Union of Forest Research Organizations. The Ontario red and white pine does not seem different from native stock. At the end of the first season's growth significant differences in germination, survival, height growth and color appeared in the test of Norway spruce.

Cytological Aspects

Cytological investigations must accompany research in heredity and variation since they provide information needed for intelligent planning of breeding research and for interpretation of the results of such research. Study of pollen-tube penetration, for example, may throw light on the cause of incompatability or failure of seed to set from certain cross-pollinations. Again, determination of chromosome number, serves to show the possibility of hybridizing different species and to verify the parentage of progeny. Finding that 19 species of oak have the same chromosome number indicates that chromosome number differences will not be a factor in breeding with this genus.

A study of Acer rubrum from various parts of its range is being conducted to determine the significance of natural polyploidy. Polypolidy, which is associated with chromosome behavior, may radically alter the normal rate of growth or technical characteristics of a given species and offers one means for possible improvement of forest trees.

The fact that bagged branches of birch left unpollinated for experimental control have developed large numbers of fruits containing some fertile seed has cast suspicion on the parentage of all birch seed derived from controlled pollination and has made it necessary to determine the proportion of such seed. Investigations on this problem during 1940 indicated that about 2 percent of the ovaries in unpollinated catkins of Betula papyrifera develop fertile seed. Cytological studies to determine the mechanism of this phenomenon have already yielded an outline of the chronology of embryo development in paper and yellow birch, and should eventually show the influence of the production of seed without pollination on inheritance in the birches.

Physiological Aspects

Clonal propagation of forest trees provides the means not only for immediate utilization of the best native trees or hybrids, but also for the multiplication and perpetuation of germ plasm needed for fundamental research in heredity and variation. During the past year the optimum techniques developed in previous work were used to root cuttings of 19 trees from which controlled pollinated seeds have been obtained.

Dormant white pine cuttings planted in outdoor propagating beds did not show any significant response at the end of the first season to any particular storage or chemical treatments from the standpoint of rooting, though differences in survival were obtained. Greenwood cuttings treated and planted in the summer of 1939 and mulched during the winter of 1939-1940 showed a differential rooting response ranging from zero to a maximum average of

55 percent at the end of the second season. Some factors which influenced rooting of these greenwood cuttings were (1) age of tree, (2) position from which cuttings were taken, (3) optimum auxin treatments, (4) type of outdoor propagating beds, and (5) clonal variation. The results also indicated the possibility that fungi aid in the rooting of white pine.

Greenwood cuttings of oak, sugar maple, and basswood given various physical and chemical treatments had not rooted at the end of the first season. These have been carried over the winter in mulched beds for observation next year.

An important objective in technique to facilitate breeding work was attained by experiments which showed that red and white pine pollen could be carried from one breeding season to the next by storage between 0° and 4°C at about 50% relative humidity. The test pollen remained over 80% viable after 413 days storage. Preliminary work on the application of these results to storage of hardwood pollens gave promising results, particularly with species of maple.

Practical Application

At the outset the station had access to a large number of hybrid poplars which had been developed by the Oxford Paper Company. An evaluation of the more promising of these hybrids was therefore initiated by distributing stock for planting in nurseries of cooperating agencies throughout the country. The data on growth and development of these hybrid poplars, though not completely analyzed, indicate the clones which may be expected to do well in any particular region. However, it is apparent that nursery tests will not provide adequate information on adaptability of the hybrids to different soils and climatic zones because of the lack of uniformity in handling of the stock, particularly with respect to differences in fertilization and irrigation. Some of the cooperating agencies have established field plantings after rooting the cuttings in the nurseries. In a few years these field tests should provide satisfactory information on comparative adaptability of the hybrids to different soils and climatic zones. Similar tests will be attempted in the future as stock of other promising hybrids becomes available.

MENSURATION

Forest mensuration work has been under way since the Station's establishment in 1923. Standard volume tables for the principal northeastern species are fairly complete, growth and yield studies of spruce-fir even-aged second-growth stands, published in 1928, are being checked on a long-term basis, and

regional growth tables for northern hardwoods are being prepared. With the completion of several reports on past work, mensuration will logically become primarily a service section advising others on measurement technic and experimental design. However, studies leading to a broader understanding of such factors as mortality and the approach of understocked stands toward normal stocking will still be maintained.

The survey and type map project conducted by the CCC in southwestern Maine in 1936, 1937, and 1938, was omitted in 1939 and 1940, relieving the Station of demands for technical advice which helped to maintain high standards of accuracy in the past. Adequate material has been obtained for the statistical control of the national forest survey when it is extended to the northeast. If the CCC survey project is resumed the intensity of inventory can be reduced to a third or fourth of past practice. From this survey of nearly 2 million acres, information has been extracted which will be of high value in planning silvicultural control of gypsy moth for an area probably aggregating 5 million acres in extent.

PLANTING

After an initial comprehensive survey of forest plantations and an analysis of forest planting problems in the Northeast, the effort of the Northeastern Station in this field was directed along the following lines:

1. Studies of effect of method and depth of planting upon survival, growth and root development.--The results of experiments with conifers set up for this purpose have been summarized in previous annual reports. Tests with rooted and non-rooted cuttings of hybrid poplars on old fields show that success can only be achieved by removal of sod and cultivation, either in wide furrows or spots at least 2 ft. in diameter, and by spacing which will result in closed canopy in 2 or 3 years. Poplars cannot cope with grass competition.

2. Establishment of mixtures of conifers and hardwoods, by variations in arrangement of strips and groups and by "skeleton planting".--Initial efforts in establishing hardwood-conifer mixtures have shown promise with red oak and white ash, but good results have not been obtained with black locust, black cherry or basswood. Contrary to original expectation it now appears that hardwoods should be established prior to planting of conifers in mixed plantations. It is still too early to draw conclusions on the effectiveness of arrangements of species tried in these experiments. Experience with these studies makes it clear that additional work on the technic of planting hardwoods is urgently needed. While some progress is being made with the production of hardwood

planting stock in the nursery, especially by the New York Conservation Department, satisfactory results are not being obtained in getting the stock established in the field. The Agricultural Experiment Station at Cornell is most active in dealing with this problem.

3. Technique and species for reforestation of areas of excessive moisture or heavy competition.--This has been followed only as a secondary effort. Results so far are not encouraging. Establishment of several species and stocks tried for wet areas has not been satisfactory. Sturdy 4-year transplants of pine will overcome heavy competition from golden-rod, timothy, etc. but poisoning to eliminate competition of woody species has not proven practical or permanently effective.

4. Development of a complete and simple system of nursery and planting records.--The early attempt of the station to obtain detailed records of a large number of plantations demonstrated very forcibly the inadequacy of data on origin and history of most of the plantations in the region at that time. Thus, in order to facilitate and stimulate the accumulation of adequate data for the future, the station developed an interlocking series of forms for recording source and treatment of seed, treatment of stock in nursery and details of field planting. Use of this system, for even a fraction of the stock produced at state nurseries, would provide useful information for interpreting plantation results. The record forms were distributed to all state foresters but have only been partially adopted, although the need for analysis of established plantations appears to be as pressing as ever.

5. Testing adaptability of promising strains of desirable species by field plantings of stock of known origin.--A series of plantings of Scotch Pine under widely different site conditions is showing variations in form which may have some relation to environment.

Changes of personnel and restrictions of available funds have handicapped the planting project for several years. Because of the necessity for further retrenchment this year, and because it is no longer possible to maintain a CCC superintendent at the Chenango Experimental Forest, the work in planting has now been reduced to maintenance of established long-term experiments and analyzing results of recent years. It will not be possible to undertake certain desirable expansion of the work in establishment of hardwood-conifer mixtures, which probably remains the most urgent long-range problem in the planting field. Under these circumstances we must look to other agencies for progress until more money is again available to the Station. Perhaps the states are in better position than the station, in any event, to handle such experiments as planting technic, adaptation of species to site and establishment of mixtures.

FOREST FIRE PROTECTION

Lack of funds necessitated the termination of forest fire research last July when Mr. Stickel, the project leader, was transferred to the Northern Rocky Mountain Station. During the first half of the year reports on all work in progress were prepared for future reference. Further observations on plots which have been used for the fire damage study will be made in connection with other forest management work.

Substantial progress was made in developing a technique for measuring thermal conductivity of bark but this special phase of the fire damage project was left uncompleted. An apparatus was devised to determine the time required for a constant source of heat applied to the surface of bark on freshly cut bolts to raise the temperature of the cambium layer to the death point. Preliminary tests were made with beech, balsam fir and hemlock. Beech bark offers less protection than fir bark of the same thickness. The role of dead outer bark in increasing heat resistance is clearly shown by comparison of tests for balsam fir 15" in diameter with bark 0.4" thick and hemlock about 9" in diameter with bark 0.5" thick. Dead outer bark constituted about 78% of the total thickness in the hemlock but only 40% in the balsam fir. As a result the balsam specimens were killed in about 6 minutes when a temperature of 450° C was applied but the hemlock endured this heat, which badly charred and in some cases caused the bark to burn, for 13½ minutes. It is hoped that opportunity may sometime be presented to complete this study by obtaining additional data on the three species already tested and by extending the tests to sugar maple, chestnut oak and pitch pine, the other species whose bark has been studied anatomically and with respect to seasonal variations in moisture content.

FOREST ECONOMICS

Forest Cooperatives

The activities of the Station in this field during 1940, as in previous years, have been concentrated on the Otsego Forest Products Cooperative Association at Cooperstown, New York. Called into the area by local people, the Station made recommendations which led to the formation of this pioneer cooperative enterprise in December 1935. In spite of its limited experience and the many vicissitudes which it has had to meet, this association has already made significant contributions to farm forest management and general farm economic information. Progress to date, although

slow, has shown that the original recommendations were fundamentally sound. Experience of the past year, as the Association passed from the period of construction to regular operation, has tended to bring into sharper focus than ever before the many peculiar problems confronting organizations of this type. The bulk of these problems lies in one or another of six fields, namely (1) forest management, (2) membership and education, (3) raw material supply, (4) raw material processing, (5) sales, (6) cooperative management.

The field of forest management is the foundation upon which all other activities must be based. It is essentially a technical field and embraces all the activities connected with the control of the resources. The Station staff has handled the problems in this field in their entirety. It has carried on the actual control work based upon principles and techniques worked out in previous years. This involves location of the woodlots, the classification of stands as to operability, taking of a growing stock inventory and the marking of timber to be cut. It has been found possible to carry on this forestry control effectively and at reasonable cost under the pressures of full scale commercial operation. The actual cost of such work will vary primarily with the length of cutting cycle; thus, with a three to five year cycle, and one inventory to three markings, the cost of growing stock control will run about 20¢ per acre of merchantable timber per year. With a longer cutting cycle the cost would be less. Some of the problems which arise in this work deal with such things as determination of desirable crop trees, thinning methods, and control of species. At the same time, while applying the theoretical sustained yield cut, the degree and type of cutting must be balanced against the practicability of logging and the need of the owner for income. This has led to formulation of minimum standards of cutting, together with clear cut principles of marking and guides to optimum growing stock. The forestry program has been well received; logging has generally conformed to the marking and cutting of fuel following logging has served to utilize unmerchantable material.

Membership and educational work inevitably require a large amount of time in the development of a cooperative organization. The station has participated to a considerable extent in the educational work but all the actual solicitation of members has been carried on by the Association. The educational work not only involves technical background but also a thorough understanding of the psychology of the people.

One phase of the educational activity has been lectures, aimed at promoting a general understanding of the project, to organizations such as local granges, vocational agricultural classes in the high schools, and Rotary and Kiwanis clubs.

Another phase of the work has been educating members and other interested farmers in the actual techniques of forest production. This has been done through a series of small group kitchen meetings and through field demonstrations. These activities have yielded valuable "slants" on the efficacy of various educational devices and have resulted in noticeable improvements in both understanding of the project and in forest practice.

The actual signing of members and frequently much of the educational work is carried on through means of individual contacts by Association field men. The nature of the Association requires a great deal of explanation and a great deal of sales effort. However, during the year membership was practically doubled, the total at the end of the year standing at 640 after absorbing losses which have run about 10%.

The real hurdles which have to be overcome in the enlistment of members have shown up very clearly, indeed, during the past year. The first obstacle is a general lack of knowledge of the principles of forest management on the part of the farmer. The relatively small forest area owned by many is a factor which is not conducive to interest in timber production. Another adverse factor is the lack of objective in regard to forest lands. Farmers generally own forest land simply because it is part of the farm. Since farmers are primarily interested in the production of milk and eggs and because, in the past, proper marketing facilities have not been available, the forest land is regarded merely as a source of wood or of occasional cash income, rather than as additional crop-land. Another factor which impedes the progress of a project in this field is the competition for the time of community leaders from the various land use programs being stimulated by the government, as well as from other agricultural activities. It is found that while leaders are interested and will support this program as well as they support other sound farm programs, the initiative and energy to carry the program to action must come from the management of the Association rather than from the individual members. Another factor which is shown in this connection is what might be termed a lack of ambition on the part of many farmers. One of the basic tenets of the Association has been that labor income is just as desirable as resource income. Many farmers, however, feel that unless they can get a good stumpage return they are not interested in working through an association. Then, increased industrial activity this year has made itself felt in this area through a demand for forest raw materials and an increase in the number of log buyers. This introduces an element of direct competition which has not been serious so far but which has required greater effort on the part of the Association than would normally have been required.

The field of raw material acquisition includes the activities connected with extraction of the products, their transportation to the plant and their measurement and grading. In this field, as in others, considerable education has been necessary in order that the member will not only do a good job in his woods but get the most out of it financially. Due to the necessity of obtaining a steady flow of logs early in the fall before members had completed other farm work, a relatively large percentage of members have hired their neighbors or other workmen to get the logs out for them. As a result the Association has had to assume responsibility for many of the arrangements incident to getting cutters on the job, hiring teams and negotiating with truckmen. It has been difficult to get the members to appreciate the necessity of scheduling their logging activities so that the mill could operate without interruption. Furthermore, not many of the farms are properly equipped with respect to tools, sleds or harness for heavy logging and there are few trucks in the locality specially suited to hauling logs. Finally with a large part of the work done by hired crews, it has been difficult to integrate the many small operations so as to utilize effectively the available teams and labor or to make the work attractive to independent contractors.

However, assiduous efforts on the part of the field men are gradually building up a trained corps of reliable woodsmen and truckers who look to the association's activities for regular employment. When operations have been fully established it may be expected that a number of independent contractors will be set up in the territory devoting their major effort to the Association's raw material supply and assuming full responsibility for all operations from stump to mill pond. Such contractors, besides rendering a valuable service to members who are not in position to do their own logging, will assure a steady flow of logs to the mill and tend to prolong the active logging season beyond the period when farmers can devote time to woods work.

During the year 176 logging contracts involving about 1,750 M bd. ft. of logs were entered into by members. All logs delivered are measured by the Association's scaler and paid for according to the Doyle rule. Although this rule is not considered in a favorable light by many foresters and, although from an academic standpoint it has some weaknesses, analysis shows it to give the fairest measure of value which can be recovered from hardwood logs.

On the basis of experience during the year it seemed advisable to modify the Association's log grade specifications somewhat. A minimum specification for No. 3 logs was established, upper grades for hardwoods were somewhat liberalized, and members were given the option of selling hemlock woods-run rather than by

grade. A considerable amount of educational work is still needed before the log grades can be considered as having been fully accepted by the local people.

Requests for service from farmers residing at distances of more than 20 miles from the central plant, have raised a question as to how effective the Association's forestry program could be in the case of such distant operations. Obviously, as the hauling distance increases the margin for stumpage is reduced. Therefore, members situated at a relatively great distance from Cooperstown can afford to ship only the better grade logs to the central mill and so the opportunity to improve their growing stock, or even get full utilization of good trees cut, would be greatly reduced. To meet this situation and extend the area of the territory served, consideration was given to the establishment of "feeder mills" at outlying points operating under contract with the association. As an experiment, one such feeder has been set up near Morris, about 30 miles from Cooperstown, and it is expected that about 350 M feet of logs will be delivered to this site, there to be processed by a small mill. Certain grades of lumber will be put into preloaders and hauled green to the Association plant for remanufacture. Other grades, principally softwoods, will be stored on the site until dry and then shipped either to the home plant or directly to consumers.

In the processing field great strides have been made. The mill, which at the beginning of the year was nearing completion, has been put in an operating condition. This included tuning up the machinery, making necessary adjustments, installing safety and sanitary features, installing a high speed moulder and making further developments of the yard. The mill crew, largely recruited locally, has been trained to a point where the anticipated production of 17 M bd. ft. per day has been attained. Output between October 1 and the end of the year was approximately 600 M bd. ft.

There are still many unsolved problems in the processing field. Perhaps the most fundamental has to do with the handling of low grade material so as to give a market for a greater portion of the forest products than can be afforded if only a log market is offered. In the fall, the Association offered to purchase bolts but response from the members has not been satisfactory. Apparently operating methods cannot be easily adjusted to handle both logs and bolts in small farm operations.

Another intricate problem is that of broadening the outlets for certain classes of hardwood lumber by cutting it into small dimension stock for furniture manufacturers, and numerous special uses. The difficulty in this field lies in integration of production and sales so as to permit relatively full utilization by cutting of several different sizes simultaneously. Another difficulty is setting up facilities flexible enough to

assure efficient handling of the many sizes and grades of finished stock which the business develops. Here is a large field for studies of costs and recoveries in production and handling of various items. The station has already made certain "spot" tests and done some exploratory work in anticipation of more comprehensive analyses during the year ahead.

The marketing phase of the program per se has presented little difficulty. The demand has been generally good and prices reasonable. However, balancing of orders with production of the mill presents quite a problem because of the number of species to be handled and the heretofore uncertain delivery of any kind and type of log. Outlets must be developed which will give the greatest possible utilization and at the same time fit into production schedules. This applies particularly to the hardwoods. Except for the lowest grade material, disposal of the softwoods has not presented a serious problem. This is due to the fact that members themselves buy back a great deal of the softwoods produced.

During the year an attempt was made to market peeled poplar pulpwood. However, difficulty was experienced in getting labor to cut and peel the wood during the summer months and only about 100 cords were marketed. Whether or not this field will be followed up will depend entirely upon the labor situation and the price level during the coming year.

The field of cooperative management involves the problems of over-all direction of the association's business in which exercise of fiscal control pulling all the strings together and correlating all activities are important considerations. The erratic character of operations up until the fall of 1940 has complicated problems in this field. Such conditions have not been conducive to a stable work-load which could be analyzed and assigned. Hence, the set-up in the managerial field has been experimental and subject to frequent change. The primary breakdown of functions segregates those dealing with membership and raw material acquisition; those dealing with operation of the plant; those dealing with sales of the products, and those involved with general business management. Experience has indicated that further readjustment of management is needed.

Early in 1940 it became apparent that the capital of the Association was not sufficient to carry through the development period still ahead. Analysis of the situation was made by B. T. Dodder of the Farm Security Administration and J. W. Girard of the Forest Service with the result that additional funds in the amount of $84,000 were made available to the Association, primarily to augment its working capital. During the summer the Farm Security Administration also made a complete audit of the Association books for the fiscal year ending June 30. During the first part of the year the Farm Security Administration took a more active part in

the administration of the loan under dual arrangement which had been developed in connection with the supplementary loan; however, by the end of the summer this arrangement appeared to be impractical, due among other things to the work load on qualified Farm Security Administration men. Accordingly, in October full responsibility for the loan was turned over to the Forest Service.

This experimental effort to establish a cooperative forestry enterprise covering the entire field from forest management through to marketing of products in primary stages of manufacture to fabricating industries and other consumers still faces many problems. In themselves these are not discouraging; in fact the reverse is true, because only as specific problems present themselves can they be analyzed and solved. If all phases of the program can be properly integrated and brought to a satisfactory level of efficiency, there will be little question that this contribution toward effective management of forest land in scattered small ownerships will be of great significance in putting to productive use much of the land and labor being released in the process of agricultural adjustment throughout the country and in cushioning locally the impact of post-war shifts of industrial activity.

Farm Forestry (New York) - Consumption and Outlets for Farm Forest Products

Inauguration of a cooperative farm forestry demonstration project in the white pine region at the head of Lake Champlain in New York was accompanied by a request for investigation of home consumption and marketing of farm forest products from a unit comprising all of four towns and parts of two others lying between the high mountains and the lake in Essex County. Although the work is conducted by the Northeastern Station, the project involves cooperation under the Norris-Doxey Act from the New York Agricultural Experiment Station, the New York State College of Forestry and the New York State Department of Conservation.

After locating all operating farms within the unit, (444 in number) a random sample of 25% was drawn for intensive study. Hill farms were segregated from valley farms in compilation of the data, which included term of occupancy by present owner or tenant, land area by use classification, size and description of all buildings, timber stand, amount of forest products used and sold annually for a five-year period, elements of woods expense, gross farm income and farm operating expense.

As a correlary to this endeavor it was possible to obtain a great deal of information for the unit as a whole covering such points as ownership of land, general condition of timber and approximate forest growth.

In addition to the above 112 markets available as outlets for forest products from the unit where analyzed as to quantity and

source of raw material requirements, prices paid, purchasing method, type of production, amount of employment provided and adequacy of facilities from standpoint of farm woodlot economy.

In the unit studied less than 1/4 of the total area is in operated farms. On the valley farms 45%, and on the hill farms 56% of area is wooded. In the merchantable stands, which constitute almost 70% of the total, the volume of all products averages approximately 2000 cubic feet per acre of which 2/3 is fuelwood and only 1/5 saw logs. Although white pine is the principal commercial species, it constitutes only about 1/6 of total cubic volume.

The average farm uses annually about 1282 cubic feet of wood in various forms and for various purposes; 89% of this is fuelwood and the remaining 11% is lumber, fence posts, rails and stakes. About 70% of the lumber and fencing and 90% of the fuelwood consumed annually are taken from the farmers' own woodlots, the remainder being purchased elsewhere.

Farm buildings constitute a potential channel for the utilization of a substantially larger volume of lumber than at present. Farm buildings, averaging 9 in number on each farm, contain about 62 M bd. ft. of lumber on the valley farms and 51 M bd. ft. on hill farms. These buildings average almost 50 years in age. Many of them have not been maintained currently and are in rather dilapidated condition. It is estimated that it would require about 4 M bd. ft. of lumber per farm to bring the buildings up to a satisfactory state of repair, while normal maintenance might be set at about 1 M bd. ft. per farm annually. Current maintenance is actually using only about half this amount. It is interesting to note that of all lumber used for maintenance 84% is new native material, 14% comes from old buildings and only 2% is imported from other regions.

In addition to this home use, the farm woodlots in this unit produce for sale about 570,000 cubic feet of wood, of which 84% is fuelwood, pulpwood and low grade logs which have a sale value of 8¢ per cubic foot. White pine bolts, sold for box manufacture, bring only 5¢ per cubic foot, high grade logs and lumber average 14¢ per cubic foot and fence posts are worth 29¢ per cubic foot. A limited quantity of maple syrup, Christmas trees and wreath material also add to cash income on a number of farms in the unit.

Woodlots play a relatively unimportant part in the income of the farms studied, but they could assume larger significance if the forest growing stock were restored to better condition by sound management. Hill farms derive 10% of their gross income from the

woodland while on valley farms where total income is substantially greater, only 5% is obtained from forest products.

Almost all (92%) of the forest products cut from farm woodlands are sold to markets located within the unit. The remainder goes but a short way to other markets. It is interesting to note, however, that the industries do not depend completely upon farm woodlots for their raw material as only 25% of the raw material intake of the industries within the unit comes from farm woodlots. The markets within the unit, when considered from the standpoint of ability to absorb all classes of forest products, are satisfactory.

An interesting sidelight of this study was an analysis of practices of 25 log buyers located both within and without the unit. These buyers, representing various classes of mills, used 5 different log rules as buying units as well as weight and mill tally. The log rules used were Doyle, Scribner, Saranac Standard, Glens Falls Standard and International. When converted into a single standard, the prices paid showed a surprisingly small range for the majority of products purchased. Certain mills paid extremely high prices due to the types of business they were in. The price paid by the purchaser by weight appeared to be entirely too low in comparison to the others. However, when cull and the generally low grade of material purchased by the method are considered this price is perhaps not far out of line with the others.

FOREST PRODUCTS

For several years the station has persistently called attention to the need for forest products and utilization research in the Northeast. It is quite generally recognized that for much of the region widespread forestry practice is not being held up so much by lack of knowledge of forest management as by economic obstacles, many of which may be removed by forest products and utilization research. During the past year, after discussion of the matter at earlier meetings of the Northeastern Forest Research Council, the station prepared and distributed to other agencies engaged in this field of research, an analysis of forest products problems and needs in the region.

Forest Service activities in the field of forest products research in the Northeast should be divided between work to be undertaken in the region under the direction of the Experiment Station and work to be conducted at the Forest Products Laboratory. Work to be done in the region itself includes that which is industrial in character and that which is in the nature of working out local application of basic principles developed at the Laboratory. Research at the Laboratory should concentrate on problems

of more or less fundamental nature and on work requiring expensive and heavy equipment such as that dealing with technical properties, pulp and paper making.

Of highest priority for work to be conducted in the region would be development of new equipment and methods for timber harvesting and primary processing, studies of net conversion values for a wide range of species and products, additional work on fuelwood, charcoal and wood-gas utilization, and systematic analyses of consumption and trends in local industries, of use specifications and of outlets available to specific production units.

The Forest Products Laboratory program dealing with northeastern needs should emphasize the utilization of small and low grade material for construction, new uses (including investigations in such fields as plastics and fermentation), lignin utilization (including recovery of lignin from pulp mill waste), pulping processes and equipment for oak and pine, relation between technical qualities of wood and growth conditions and development of equipment for utilizating wood gas as utility in rural communities and institutions and for trucks, tractors, air compressors and other equipment used for logging or forest road construction.

It is important that advances in the field of utilization be correlated with progress in forest management. In order to provide convincing evidence on the justification for and limitations on forestry practice on both public and private lands, utilization research must be tied in with studies in the fields of silviculture, growth, and the economics of forest management, and also with reliable data on the resource itself, which can only be supplied by the Forest Survey. This may well involve consideration of public regulation because experience has shown all too clearly that each new form of utilization and each technological advance in the manufacture of forest products, applied without regard for conservation of growing stock or permanence of raw material supply, has carried forest depletion to a more advanced stage.

Connecticut Farm Forestry Fuelwood Study

The nationwide problem of economical utilization of low grade forest products is nowhere more important than in Connecticut. Here, not only is there a deficiency of high grade products and an abundance of low grade material available in the forests, but also Connecticut is a highly industrial zone consuming enormous quantities of fuel, most of which must be brought in from other regions. Hence, efforts to facilitate or stimulate the use of wood for fuel would not only aid in the application of sound forest management, but would distribute within the state part of the money

now required for transportation of fuel from distant points. The importance of this is of special significance at present, when it is recalled that during the last war a great increase in the utilization of wood fuel was brought on by a shortage of freight cars which resulted in local scarcity of other fuels. Thus experiments aimed at increasing the use of wood fuel in New England may make a positive contribution to the current preparedness program by serving to release freight cars for other emergency purposes.

In November 1939, studies of the production and utilization of hardwoods for fuel in Connecticut were started with Norris-Doxey cooperative farm forestry funds, and, thanks to a private donation obtained by the Connecticut Forest and Park Association, will be continued at least to July 1, 1941.

The form in which wood can be burned has an important bearing on costs, convenience and efficiency. Information is available on the use of sawdust and hogged wood as fuel, but the application of such use has been largely confined to industrial plants and to the West coast where such materials represent a waste product. Since equipment for the handling of this material can be procured, but reliable figures on the cost of the production of hogged wood from cordwood were lacking, plans were made to prepare the necessary fuel and test its use in the heating plant of one of the state institutions. Performance of this boiler while using coal has been studied for one season. If and when it is possible to have satisfactory stoking and combustion equipment installed, parallel tests will be made using hogged wood as a fuel. Studies of the preparation of the fuel indicate that cordwood can be hogged at about one dollar per cord yielding about 200 cu. ft. of chips.

In the development of equipment and methods for the more economical production of fuelwood, several devices for handling wood in packages are being tried and tests of the effect of length of stick on skidding and other production costs are under way in cooperation with the Connecticut Forest Service and the CCC. The need for such work has become apparent to a number of individuals in New England who are independently attempting to solve some of the problems by inventing and testing a number of kinds of tools and equipment.

The need for and increasing interest in wood burning heaters for homes has brought about the development of several makes of such equipment operating on the slow-combustion principle. Service tests of the Char-Wood Heater showed high efficiency and economy but indicated that further work on design is necessary to eliminate the objectionable features of mechanical failures and the emission of smoke and ash at the time of firing.

Charcoal is used widely in Connecticut, the largest amount being consumed by tobacco growers. A very marked rise in price has recently been made and supply is now far behind demand. Ordinarily only a very small margin for profit exists. To reduce costs of production of charcoal from locally grown hardwoods, the Connecticut Agricultural Experiment Station,as a part of this cooperative project, is working on the development of a portable charcoal kiln. A rectangular kiln has been built which is giving fairly satisfactory results both in quantity and quality of the charcoal produced. It is truly portable since the heaviest section weighs less than 300 lbs.

Exploratory work on the use of producer gas by state institutions showed the use of wood gas to be impractical at present since fuelwood would have to be produced at about $4.20 per cord in order to compete with coal.

The work done in Connecticut has aroused a lot of interest and should be more adequately financed. State agencies are ready to contribute their half of a considerably higher allotment in order to get results leading to solution of the low grade hardwood problem in southern New England. It should be a high priority project even if there were no farm forestry funds, but present commitments and recent allotment cuts make it impossible to divert any appreciable amount to this work from regular funds.

FLOOD CONTROL SURVEYS

Administration of all watershed surveys in the northeastern region was transferred to the Allegheny Forest Experiment Station in July. This effected some economy, but was primarily justified by simplification of administration and cooperative relations with the other bureaus participating in the surveys since these bureaus cover the Northeastern as well as the Allegheny territory from their regional offices in Philadelphia.

During the fall opportunity arose to present our viewpoint on headwaters control and to outline progress of the surveys on both the Merrimack and Connecticut riversto the New England Drainage Basin committee meeting in Boston to consider plans for work on these watersheds by the Army Engineers and other agencies. In reviewing the results of our survey on the Merrimack River, summarized in last year's report, it was pointed out that the cost per acre-foot of supplementary storage in headwaters ponds on one tributary was less than the average for the 3 large Army projects. Consideration was also given to the handicap to any watershed program from present policy of requiring that any work proposed on the headwaters must be economically justified in relation to residual damages left after benefits of the previously authorized

army program have been taken out. Since the larger dams do not provide any measure of local protection in the rural districts the people whose welfare is the particular responsibility of the Department of Agriculture are left largely unprotected. It is a question of public policy whether a unified program for the entire watershed, starting at the headwaters and working downstream and combining those measures (whether of land management, headwaters ponds or large dams), which would give the largest benefits within the limit of cost, would not be more economical in the long run. This question was considered further at the meeting dealing with the Connecticut River and the Committee adopted a resolution, which read in part, as follows:

> "That in order to effect maximum distribution of benefits and attain optimum development of the Merrimack and Connecticut watersheds any technically and economically sound measures which may be proposed in the future, whether for flood control, for supplementary storage, or for improved land management, should be considered along with structures or measures previously authorized as parts of an integrated program, the justification of which should be based on an over-all benefit-cost ratio."

Analysis of damages on the Connecticut River shows that the critical areas contributing to floods lie between the Amonoosuc and the Millers rivers. Supplementary damages on the headwaters not considered by the Army were found to amount to about $750,000 annually. Work on the Connecticut Survey is being concentrated on the area above Bellows Falls, Vermont. Damages from summer and fall storms will be differentiated from those of winter and spring storms since the problem of retardation of run-off differs quite widely with the seasons. Analyses of hydrology and of damage frequency will be much more intensive on the Connecticut than was possible on the Merrimack. Furthermore, records are being obtained of run-off from small drainages representing different types of cover, snow surveys are being conducted and experiments to determine infiltration rates have been initiated. Thus, more significant data should be available upon which to formulate final recommendations, than was the case with the Merrimack.

Interesting results on soil freezing in relation to forest cover were contributed by studies covering 3 seasons at the Gale River Experimental Forest. It was found that forest cover has a mitigating effect on late fall floods because of the delay in ground freezing prior to snowfall in soils protected by tree growth and because the forest soil when freezing, forms a loose somewhat crystalline structure, which retains permeability well into, if not through, the winter. On the other hand soil in the open freezes solid early in November.

Beyond this the depth and time of soil-freezing and the rapidity of thawing vary with the type of forest. Frost penetration is least in hardwoods, much deeper and about equal in open or in spruce flat type, and greatest in spruce swamp. Thawing began and was completed earliest in the hardwood stand. The open field ranked second in this respect, followed by the spruce flat and the spruce swamp. These findings are related to varying depth to which protecting snow cover accumulates in the different types.

FOREST INSECT INVESTIGATIONS

Forest Insects Laboratory, Bureau of Entomology
and Plant Quarantine, New Haven, Connecticut
R. C. Brown, Station Leader

The European Spruce Sawfly

The infestation in the severely defoliated areas of southern Vermont and New Hampshire was reduced to a very low point during 1940 because of larval disease and because a relatively low percentage of cocoons remain in diapause in this region. In Maine disease was prevalent in September and there may have been a reduction in infestations; however, a considerable proportion of cocoons remain in diapause in that state and these constitute a potential menace to the spruce forests. A slight increase in infestation was noted at a few places in the northeast notably at higher elevations where disease was not prevalent. There was no appreciable change in degree of infestation over most of New York state where the population remains at a low point.

Detailed studies were continued in permanent sample plots located throughout the northeast. In the areas heavily infested from 1937 through 1939 the mortality has been greatest among those trees growing in the open. Little mortality has occurred in closed stands. Mass propagation of the cocoon parasite Microplectron fuscipennis was concluded, at least temporarily, with the close of the 1940 season. This parasite has been extensively colonized by the northeastern states and the federal government during recent years and it has become established at a number of places in the three northern New England states and New York. Four species of larval parasites belonging to the genus Exenterus have become established in Canada. An attempt is being made to obtain and rear these parasites for distribution in the United States.

Investigations of Insects in Plantations and Areas of Natural Reproduction

The planting of conifers in pure stands has created ideal conditions for the increase of many insects. Sawflies have been particularly troublesome recently and outbreaks have been noted of the following species: the Leconte's sawfly on hard pines in New York; the red pine sawfly, Neodiprion sp., principally in eastern Massachusetts; Neodiprion dyari on jack pine and pitch pine; Neodiprion sertifer on red pine in New Jersey and the larch sawfly in various parts of the northeast. The last two species mentioned are introductions from Europe. Another introduced species, Gilpinia frutetorum, has increased in numbers during 1940 in red pine stands in Connecticut and New York although

infestations have not yet reached outbreak proportions. The life history and ecology of these insects are being studied.

The European Pine Shoot Moth population, having recovered after the heavy mortality in the cold winter of 1933-1934, continues to work serious damage in red pine plantations in Connecticut, Long Island and southern New York. No work is being done on this insect at present.

Encouraging results were obtained in 1940 in controlling the white pine weevil by the application of concentrated lead arsentate sprays in early spring. The spray was applied to the leaders of white pine in order to poison the adult weevils before oviposition takes place. It has been found that the larvae of the root crown borer, Hylobius radicis, which attacks principally Scotch and Corsican pines, may be satisfactorily controlled by the application of ethylene dichloride emulsion.

Observations indicate that the outbreak of the forest tent caterpillar in New England is practically at an end.

Gypsy Moth Investigations

Ecological studies and investigations on the relation of forest composition to the intensity of infestation were continued in the study areas located in Eastford, Connecticut; Petersham and Freetown, Massachusetts; and Alfred, Maine.

Larval collections made at certain places in Massachusetts where the European parasite, Parasetigena silvestris has been colonized, revealed that this parasite is now firmly established in this country and is present in appreciable numbers. This is one of the outstanding parasites of the gypsy moth in Europe and indications are that it may become an important addition to the parasites of the gypsy moth already established here.

Measurement of Direct Current Voltage Gradients of Tree Tissues

Considerable progress has been made during the past season in measuring voltage gradients of various tree species (principally conifers). Portable equipment has been developed in cooperation with members of the staff of the Yale Medical School which makes it now possible to easily obtain readings of voltage gradients of trees in the forest. Readings taken on normal trees and trees in varying degrees of decadence differ greatly. It is now possible to measure quantitatively the physiological condition of a tree with considerable accuracy. The voltage gradient may, therefore, serve as an indication of susceptibility of a tree to insect attack. This is of particular importance in studying trees attacked by certain bark beetles and sucking insects.

FOREST PATHOLOGICAL INVESTIGATIONS

Bureau of Plant Industry, New Haven, Connecticut
Dr. Perley Spaulding in Charge

Plantation Diseases

Progress in the survey of diseases in plantations has been slow but steady. A total of 135 plantations have been examined. The following diseases are of special significance:

Valsa (Cytospora) abietis, generally distributed on Pinus strobus; on weakened trees and branches.

Armillaria mellea, on trees of all species which are in sub-normal condition.

Polyporus schweinitzii, a real parasite on all conifers, causing root and butt rot.

Tympanis disease of Pinus resinosa affecting trees outside their natural range.

Valsa (Cytospora) sp. attacking Norway spruce where badly crowded. Experiments, although damaged by the hurricane, show that fertilization leads to rapid recovery and thinning leads to the same result but at a slower rate. Poor site, drought, severe root competition and stagnation are factors inducing the disease. Frost cracks often furnish entry ports for infection.

Decay in Living Balsam Fir

Dissection studies of balsam fir in New York, New Hampshire, and Maine have been under way for a number of years. Analysis of about 1100 trees thus examined indicates that commercial cull begins at 40 years of age and at 80 years has become a limiting economic factor. For maximum returns, balsam fir should be harvested at or before that age. On the basis of diameter at breast height, cull becomes a limiting factor when the average diameter of all trees in the stand reaches 8 inches. If stand improvement is practiced, this diameter limit will be raised. Three decays cause most of the cull. Red heart rot caused by Stereum sanguinolentum was the cause of 54 percent of all the commercial cull, while butt rot caused 41 percent. The white stringy butt rot caused by Poria subacida accounted for 28 percent while the brown, cubical butt rot of Polyporus balsameus caused 13 percent of all the cull. Five percent cull resulted from all other factors.

Deterioration of Hurricane Thrown Timber

Sapstain accompanying insect attacks has largely run its course in trees which died just after the hurricane. However, there are a considerable number of softwoods which have remained alive so that stain has attacked lightly if at all. Even more of the hardwoods have survived and are in good condition still. Salvage of such trees is still possible. Decay of the sapwood is appearing where sapstain has previously held the stage. Poorly stacked hardwood lumber has become seriously infected by saprot.

White pine logs promptly stored in water are sawing out with no defect developed since they went into the water. Sapstain and decay have been held in check even in the exposed parts of the floating logs. It appears that this situation is likely to continue indefinitely, as absorption of water will continue slowly.

Miscellaneous Diseases

The leaf-cast of Douglas fir caused by Phaeocryptopus (Adelopus) gaumanni has been found in a number of new localities. It is now known in the Northeast at scattered localities in all of the states of New England and eastern New York. Experiments are under way to see if fertilization or thinning will, by increasing vigor of the trees, enable them to withstand or overcome the disease. It is too early to predict the course of this threat to Douglas fir in the Northeast, but the prospect is not reassuring for the continuance of extensive forestry planting which has been begun in late years.

The eastern white pine was damaged extensively and severely by salt spray blown by the hurricane. Many affected needles were shed prematurely. Records show that, in general, the buds survived and partially reclothed the bare branches. Where the buds failed to develop, it appears that the tree or branch usually was growing slowly or was partially suppressed.

The beech-Cryptococcus-Nectria disease is spreading in Maine. Dead and dying trees were found for the first time in an area in the vicinity of Stacyville.

FOREST WILDLIFE RELATIONSHIPS

Department of the Interior
Fish and Wildlife Service
Maine Cooperative Wildlife Research Unit
John Pearce, Leader

In August, Assistant Biologist John Pearce was transferred to the Maine Cooperative Wildlife Research Unit at Orono, Maine.

Forest wildlife relationships have been an important part of the Maine Unit's program. This work will be continued.

Pearce will also supervise the work of the forest biologist to be stationed at Massabesic Forest, Alfred, Maine. This assignment will make possible more intensive field work not only on the Massabesic but also on the Gale River and Bartlett experimental forests than could be conducted when working from New Haven. It has become increasingly clear that real progress in forest-wildlife research rests on continuity of observation on particular forest areas.

Certain projects outside of the three forests mentioned will be maintained until suitable reports can be made. This applies principally to the studies of shrub planting to improve wildlife cover in coniferous plantations at Chenango Forest, and the wildlife food plant improvement experiments at Pillsbury Reservation, New Hampshire.

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PERSONNEL

Northeastern Forest Experiment Station
1940

ADMINISTRATION

C. Edward Behre	P-6	Director
Mary E. Turrell	CAF-6	Principal Clerk
Julia J. Braun	CAF-4	Clerk-Stenographer
Marian M. Thomas	CAF-4	Clerk-Stenographer
Ruth Baum	CAF-3	Assistant Clerk
Katherine A. Fitzgerald(4½ mos.)	CAF-3	Assistant Clerk
Helen M. Wienhusen (6 mos.)	CAF-3	Assistant Clerk-Steno.
Mary E. Kelley (6 mos.)	CAF-2	Junior Clerk-Typist

FOREST MANAGEMENT

Raymond F. Taylor	P-5	Senior Silviculturist
Mary C. Weldon	CAF-5	Senior Clerk
Marguerite M. O'Neill	CAF-3	Assistant Clerk-Steno.

Silviculture

M. Westveld	P-5	Senior Silviculturist
M. A. Huberman	P-3	Associate Silviculturist
Victor S. Jensen	P-3	Associate Silviculturist
Konstantin T. Belotelkin	P-1	Junior Forester
Alfred N. Dodd	P-1	Junior Forester
Raymond Ellstrom (9 mos.)	P-1	Junior Forester
Arthur C. Hart	P-1	Junior Forester
Kalervo N. Maki (9½ mos.)	P-1	Junior Forester
Gordon M. Day (8 mos.)	SP-5	Agricultural Aide(Forestry)
J. Walter Hendrix (6 mos.)	SP-5	Field Assistant
Carlisle R. Saxton	SP-5	Engineering Draftsman
George E. Doverspike (9½ mos.)	SP-4	Assistant to Technician
Erich P. Kienow (6 mos.)	SP-4	Agricultural Aide (Forestry)
Robert E. Edwards	SP-2	Under Asst. to Technician
Alice K. Swain (1 mo.)	CAF-3	Assistant Clerk
Jack I. Greenhouse (6 mos.)	CAF-2	Junior Statistical Clerk
Dorothy Johnstone (6 mos.)	CAF-2	Junior Statistical Clerk
Joseph E. Marcus	CAF-2	Junior Statistical Clerk

Mensuration

L. H. Reineke	P-4	Silviculturist

Regeneration

L. H. Reinoke	P-4	Silviculturist
Frank E. Cunningham	P-1	Junior Forester

Forest Fire Protection

Paul W. Stickel(6½ mos.)	P-4	Silviculturist

Forest Genetics

E. J. Schreiner	P-4	Silviculturist
A. G. Snow, Jr.	P-2	Asst. Plant Physiologist
John W. Duffield	P-1	Junior Forest Ecologist
Theodore F. Breon	SP-4	Assistant to Technician
Stephen Lawler	SP-4	Assistant Field Assistant
Harold F. Ford	SP-4	Assistant to Technician
Grace Moskowitz	CAF-3	Assistant Clerk

FOREST ECONOMICS

C. R. Lockard	P-4	Forest Economist
M. B. Dickerman (6 mos.)	P-2	Assistant Forester
Donald E. Rulison	P-1	Junior Forester
John Rude (8 mos.)	P-1	Junior Forester
Harry B. Price	CAF-3	Asst. Clerk-Stenographer

FARM FORESTRY

Connecticut

Allen W. Bratton	P-2	Assistant Forester

New York

Roswell D. Carpenter	P-2	Assistant Forester
Frank S. Griswold (4½ mos.)	P-1	Junior Forester

FLOOD CONTROL SURVEYS (Transferred to Allegheny Forest Experiment Station, July 1, 1940)

William Mollenhauer	P-4	Forester
Benton MacKaye (4½ mos.)	P-4	Conservationist
Kenneth L. Roberts (5 mos.)	P-3	Associate Conservationist
David W. Lippert	P-1	Junior Forester
Helen Wienhusen	CAF-3	Asst. Clerk-Stenographer
Laura Lewis	CAF-2	Junior Stenographer

Connecticut

Walter K. Starr	P-3	Associate Conservationist
J. Harold Bauer	P-2	Assistant Engineer
Harold F. Morey	P-2	Assistant Silviculturist
Nicholas Ball, Jr.	P-1	Junior Engineer (Civil)
Bertram C. Goodell(4 mos.)	P-1	Junior Forester
Halsey M. Hicks	P-1	Junior Forester
Theodore R. Jones	P-1	Junior Forester
Basil A. Plusnin	P-1	Junior Forester
George R. Trimble, Jr.	P-1	Junior Forester
Andrew J. Nelson	SP-4	Asst. Eng. Draftsman (Mech.)
Richard M. Sawyer	SP-4	Asst. Eng. Draftsman (Mech.)
H. Roger Slayback	SP-4	Assistant to Technician
Evelyn C. Emerson	CAF-3	Asst. Clerk-Stenographer

Susquehanna

Charles H. Diebold	P-3	Associate Forester
Edward B. Williams	P-2	Assistant Forester
Marshall T. Augustine	P-1	Junior Forester
Herbert J. Mols	P-1	Junior Forester
Charles E. Critchfield	SP-4	Asst. Field Assistant

PROJECT STATUS

SHEETS

RS-NE
SILVICULTURE
Harvest Cuttings
Spruce-Fir
(M-1)

February 1, 1941

METHODS OF CUTTING IN THE SPRUCE-FIR REGION

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Harvest cuttings: Spruce types.

4. Purpose: To determine best regeneration methods and cutting techniques for developing all-aged spruce stands best suited to integrated pulpwood and sawtimber production.

5. Review of past work: The technique for regenerating the commonly occurring spruce stands having an abundance of advance reproduction has been developed. Successful management consists mainly in protection of young growth from logging damage, subsequent windthrow, fire, and from excessive shading and crowding by hardwoods; regeneration of dense, even-aged immature spruce and fir, and of stand running heavily to hardwoods is more difficult. Results of studies under way indicate that removing 1/4 to 1/2 the stand 10 to 15 years previous to the final cut results in good reproduction. Inadequate softwood reproduction in stands containing strong admixtures of northern hardwoods involves a problem not yet solved. Changed seedbed conditions, dense hardwood sprouts, and invading brush growth discourage spruce and fir reproduction following cutting of spruce stands. Heavy slash smothers advance reproduction beneath it. Analysis of slash data shows that slash decay is correlated with age, aspect, elevation and steepness of slope. Softwood slash may sometimes constitute an abnormal fire hazard for 15 or 20 years.

6. Accomplishments during past year: Completion of the old field spruce cutover areas study revealed that hardwoods are becoming established in this type at the expense of spruce and fir, and that weedings must form an integral part of any program directed mainly to the production of spruce and fir. Analysis of data on logging costs in partial cutting operation in second-growth spruce stands completed. Partial cutting experiments initiated in pure spruce-fir stands in 1939 was expanded to include stands with admixtures of hardwoods.

7. Plans for next year: Major emphasis will be placed on completion of progress reports and articles for publication. Efforts will be made to locate an area suitable for a pilot plant demonstration project.

8. Date of completion: Continuous.

9. Assignment: M. Westvold.

RS-NE
SILVICULTURE
Harvest Cuttings
Northern Hardwoods
(M-4)

February 1, 1941

METHODS OF CUTTING IN NORTHERN HARDWOODS

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Harvest cuttings: Northern hardwoods.

4. Purpose: To determine the relative merits of clear cutting, tree selection, and group selection cutting methods in the northern hardwoods types.

5. Review of past work: Over a 7-year period a series of five 5-acre plots in many-aged northern hardwood types were cut selectively, removing 25 percent to 35 percent of the basal area. Comparison plots were clear cut during three successive years. On a comparable 60-acre block group selection cuttings involve the clearing in small openings of about one-eighth of the total area.

Five years after selection cutting, no change in growth rate of reserved stand was observed. Variation in growth rate of species was very noticeable, sugar maple and white ash making excellent growth, while yellow birch showed a net loss. Mortality of yellow birch trees bordering small openings more than offsets the growth of living trees of this species. As advance hardwood reproduction is generally present in abundance, it is a minor consideration in selective cutting.

A recheck of the residual stands on selectively cut plots following the hurricane, showed that 3 to 20 percent of the volume was lost. The progressively greater losses, 3, 10, 17, and 20 percent of the residual stand on areas cutover 5, 4, 3, and 2 years before, may to some extent be coincidental. On individual 1/4-acre sub-plots the initial cut plus hurricane damage removed as much as 75 percent of the original volume.

6. Accomplishments during past year: After the 1940 growing season 5-year remeasurements were obtained on the third pair of clear and selectively cut plots. A series of 15 sample plots, each 3 acres in area, was established in an area of 100 acres of all aged northern hard-

wood forest averaging 127 sq.ft. of basal area per acre. Selective cuttings leaving residual stands of 100, 80, 60, and 40 sq.ft. in basal area were replicated three times on this series of plots. On three plots to be left undisturbed as check areas trees which might have been removed in each of the four degrees of treatment were marked and tallied.

7. Plans for next year: Reports on 5-year remeasurements of three selective and three clear-cut plots, and on the development of reproduction following the removal of the overstory under tree selection and clear cutting will be prepared in 1941. Time-cost studies will be undertaken on the series of 15 methods of harvest cutting plots, providing the cutting program materializes in 1941. Attention will also be given to the results of selective cutting in Otsego County, New York.

8. Date of completion: Continuing project.

9. Assignment: Victor S. Jensen.

RS-NE
SILVICULTURE
Harvest Cuttings
White Pine
(M-3)

February 1, 1941

METHODS OF CUTTING IN WHITE PINE REGION

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Harvest cuttings: White pine types.

4. Purpose: To determine the relative merits of different harvest cutting methods in white pine types with especial reference to definition of optimum growing stock, and evaluation of factors affecting natural reproduction.

5. Review of past work: The permanent sample plots established in 1906 and later to study the development of natural reproduction following clear cutting and partial cutting, have been remeasured regularly.

6. Accomplishments during past year: Considerable progress was made in the analysis of data from old permanent sample plots and preparation of reports for same. A report covering the case history of a selectively cut white pine tract was completed as well as a project analysis and research program for white pine.

7. Plans for next year: Concentrate on completion of reports for old Forest Service plots. Prepare a manual on white pine silviculture. Analyze present growing stock on Massabesic Experimental Forest.

8. Date of completion: Continuous.

9. Assignment: M. A. Huberman

RS-NE
SILVICULTURE
Stand Improvement
Spruce-Fir
(M-1)

February 1, 1941

STAND IMPROVEMENT IN THE SPRUCE-FIR REGION

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Stand improvement in spruce types.

4. Purpose: To develop measures for increasing the production and growth rate of spruce and fir, and improving the quality of growth.

5. Review of past work: Girdling of defective overtopping hardwoods, shown to be an economical and effective method of increasing growth rate of spruce, widely adopted as a measure of stand improvement. Thinning of old-field spruce stands also shown to be a practical measure for increasing annual increment. Experiments in weeding of young spruce stands on cut-over areas and of thinning at later stages are under way. Selective pruning of crop trees to improve the quality of sawtimber yield is also in progress. Elimination of undesirable tree growth from planting sites, plantations, and stands of natural reproduction by poisoning and girdling has been studied. Poisoning, while killing the trees, often fails to prevent subsequent sprouting or root suckering. With aspen, girdling without notching is most effective in eliminating root suckers.

6. Accomplishments during past year: No new work started. All salvagable plots damaged by the hurricane have been checked and cleaned up. Considerable progress made in completing and summarizing data obtained in remeasurement of hurricane-damaged plots.

7. Plans for next year: Primary attention will be given during 1941 to completing analysis of data accumulated on various phases of the project and to preparation of progress reports. Suitable areas will be sought for establishment of thinning plots to replace those destroyed in the hurricane. Studies in weeding, girdling, and releasing will be continued.

8. Date of completion: A continuing project based largely on permanent sample plots. Progress reports will be prepared from time to time.

9. Assignment: M. Westveld.

RS-NE
SILVICULTURE
Stand Improvement
Northern Hardwoods
(M-4)

February 1, 1941

STAND IMPROVEMENT IN NORTHERN HARDWOODS

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Stand improvement in Northern Hardwoods.

4. Purpose: To determine the effects and feasibility of thinnings, weedings, and mowings in the development of northern hardwood stands.

5. Review of past work: In a thinning experiment initiated in 1932 involving instrumental records of changes in environmental conditions, some yellow birch showed signs of decadence after the second growing season but otherwise appeared thrifty and are developing satisfactorily. On the basis of 5-year records, the residual stand as a whole increased in volume about 4 percent annually; even yellow birch in spite of losses from exposure showed an increase in net volume three times as great on the thinned as on the check area. Evaporation and wind movement at first increased more than 50 percent as a result of the heavy thinning but again approached normal as the stand closed. Other plots afford comparison of different degrees of thinning in even-aged 40-and 60-year stands.

Preliminary indications of practicability of weeding have been obtained from 21 intensive sample plots established seven to eight years ago in sapling stands four to thirteen years of age. This series of plots included different degrees of release, together with appropriate undisturbed check areas. Although the necessity and economic practicability of weeding may be debatable in many northern hardwood stands, certain factors are apparent only a few years after treatment. Stands, where a sufficient number of potential crop trees are present, should be weeded shortly after crown differentiation becomes marked-- ordinarily before stands are ten years old. Also, heavy weeding was relatively expensive and the exposed crop trees were frequently bent or broken by heavy snow. Cutting of stems competing with crop trees at any convenient height was effective and more economic than poisoning or partially severing the weed trees. Mowing in conjunction with harvest cuttings has been highly satisfactory from the

silvicultural standpoint as the usual understory of stagnating crooked reproduction is converted to a fast growing stand of straight saplings.

6. Accomplishments during past year: A progress report on the birch thinning plots was prepared, an abstract of which was the basis for Technical Note No. 33, entitled "Results of Thinning and its Effect on Residual Yellow Birch and Associated Hardwood Species."

Basic data were compiled on five-year development of weeding areas. In view of the negligible benefits of weeding, as evidenced by the analysis of diameter and height growth in weeded and unweeded stands, the practicability of weeding many young northern hardwood stands would seem open to question.

7. Plans for next year: A brief memorandum progress report will be prepared on the negative results so far obtained in weeding.

A five-year progress report on thinning will be written.

Additional areas will be selected for experiments in light thinnings to supplement those damaged or lost as a result of the 1938 hurricane.

8. Date of completion: Weeding - 1950
Mowing - 1943
Thinning- Continuous

9. Assignment: Victor S. Jensen.

RS-NE
SILVICULTURE
Stand improvement
White Pine
(M-3)

February 1, 1941

STAND IMPROVEMENT IN WHITE PINE

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Stand Improvement: White pine types.

4. Purpose: To develop measures to increase increment, quality, and volume production of white pine types.

5. Review of past work: Thinning and weeding studies were begun in 1906 and additional work on established plots was started in 1930. Experiments in silvicultural control of gypsy moth were set up in 1937 on the Massabesic Experimental Forest and on the Wendell State Forest in Massachusetts. Yale University, Harvard Forest, and Vermont Agricultural Experiment Station have made comprehensive studies and have reported on cleanings, release cuttings, thinning, and pruning in white pine.

6. Accomplishments during past year: Further progress made in compilation of data and preparation of reports on old Forest Service plots.

7. Plans for next year: Continuation of: (1) plot data analysis; (2) gypsy moth control through silviculture; (3) possible cooperative studies in wildlife and ribes control. Preparation of manual on white pine silviculture.

8. Date of completion: Continuous.

9. Assignment: M. A. Huberman.

RS-NE
SILVICULTURE
Silvics
Spruce-Fir
(M-1)

February 1,1941

SLASH STUDIES IN THE SPRUCE REGION

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Silvics: Ecology of slash in spruce types.

4. Purpose: To determine the effect of slash on reproduction and the rate of slash decay and its relationship to the protection of forests from fire.

5. Review of past work: Studies show that dense softwood slash not only kills advance reproduction beneath it but effectually prevents the establishment of new reproduction for a period of 15 to 20 years. Hardwood slash rarely hinders reproduction seriously for more than five or six years. The rate at which slash decomposes varies greatly with respect to species, as wellas size of material. Beech, birch, and maple slash decomposes from two to three times as fast as spruce and fir. Studies of spruce slashings indicate that spruce slash persists as an abnormal fire hazard for an unexpectedly long period. From 15 to 20 years or more must transpire before spruce slashings may be considered safe.

6. Accomplishments during past year: Work last year was confined largely to compilation of reproduction stand tables for two successive 5-year remeasurements, on 1,040 milacre quadrats classified on the basis of density and species of slash.

7. Plans for next year: The third 5-year remeasurement of the slash plots will be undertaken and the data will be analyzed in preparation of a report. Further field investigations on the effect of slope, aspect, and elevation on rate of slash decay will be undertaken next summer.

8. Date of completion: Indefinite.

9. Assignment: P. Spaulding, J. R. Hansbrough, and M. Westveld.

RS-NE
SILVICULTURE
Silvics
White Pine
(M-3)

February 1, 1941

SUN SCALD STUDY IN WHITE PINE

1. Field division: Forest Management.

2. Work project: Silviculture.

3. Line project: Silvics: Ecological factors of sun scald.

4. Purpose: To determine the effect of season of exposure and degree of shade on sun scald injury to white pine.

5. Review of past work: No previous sun scald studies of white pine.

6. Accomplishments during past year: A reconnaissance of the occurrence of sun scald was made in numerous parts of the region. The exposure phase of the study, involving season of exposure and degree of shade, was initiated on the Massabesic Forest. Late in the year measurements of cambial temperatures were initiated on the Maltby Tract near New Haven by use of thermocouple and pyrometer.

7. Plans for next year: Continuation of the work initiated in 1940.

8. Date of completion: Probably in 1942.

9. Assignment: M. A. Huberman.

RS-NE
MENSURATION
Tree Studies
(ME-3)

February 1, 1941

VOLUME TABLES FOR NORTHERN HARDWOODS

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Line project: Tree studies: Volume tables for northern hardwoods.

4. Purpose: To prepare regionally-applicable volume tables for the important northern hardwood species in terms of customary units of measurement.

5. Review of past work: Tables have been prepared for white ash, sugar maple, paper birch, yellow birch, beech, giving merchantable volume in cubic feet, in board feet by Scribner rule, and in board feet by International $\frac{1}{4}$ inch kerf rule, by diameter and merchantable length. Tables for total volume in cubic feet of stem and branches have been prepared for the same species and for red maple. Complete measurements have been made of 308 trees for cordwood volume table purposes, and 77.5 cords of hardwoods have been piled repeatedly in various forms to study variations in piling, effect of species, and tree size on solid contents of stacked wood, and effect of bucking into shorter lengths on solid contents. Data have been assembled showing additional volume available with decrease of utilization limits from six to four inches, for correction of tables based on a 6-inch top diameter. Technic developed for preparation of curved-axes alinement charts of tree taper.

6. Accomplishments during past year: Technical note prepared showing the effect of species and stick length on solid contents of stacked wood. The considerable variations due to species, in 4-foot lengths, practically disappears when bucked into 16 or 12-inch lengths.

7. Plans for next year: Additional checks on the merchantable volume tables will be sought and any desirable corrections incorporated in the tables. Cordwood tables will be extended to include larger diameter classes as data become available. Technic for preparation of curved-axes alinement charts to be described for publication.

8. Date of completion: 1941.

9. Assignment: L. H. Reineke.

RS-NE
MENSURATION
Stand Studies
(ME-2)

February 1,1941

GROWTH AND YIELD OF SPRUCE AND FIR

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Line project: Stand study-- spruce and fir growth and yield.

4. Purpose: To prepare normal yield tables for even-aged second-growth stands of red spruce, pure and in mixture with balsam fir, to determine the approach to normality of understocked stands; to provide a basis for prediction of growth of spruce and fir on cut-over lands; and to prepare tables of growth which will be applicable over the whole spruce region of the Northeast.

5. Review of past work: U.S.D.A. Bulletin No. 142 was published in 1929, giving tables of yield for fully stocked, even-aged, second-growth stands of spruce and fir. Eighteen sample plots are being maintained in New Hampshire and Vermont to check these tables and to provide information on mortality, change in composition, and rate at which understocked stands approach normality. Six additional plots were abandoned because of hurricane damage. A special analysis of growth in northern Vermont and New Hampshire was made in 1936 for the Coos-Essex cooperative sustained-yield project. Data from some 400 plots on cut-over lands have been analyzed statistically to derive a mathematical expression for the volume of spruce and fir on cut-over lands, as a function of time since cutting, density (as indicated by the relation between number of trees and their average diameter), and composition (as indicated by the proportion of the total basal area represented by spruce and fir).

6. Accomplishments during past year: To aid in checking the mathematical accuracy of the volume growth equation nearly 20 percent of the original 400 plots which comprised the basis of the cut-over land study were remeasured. Stand tables for the important spruce types were constructed by age of cutting.

7. Plans for next year: Completion of report on growth on cut-over spruce lands and the report on regional growth analysis.

8. Date of completion: Indefinite.

9. Assignment: L. H. Reineke and M. Westveld.

RS-NE
MENSURATION
Stand Studies
(ME-3)

February 1, 1941

GROWTH AND YIELD OF NORTHERN HARDWOODS

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Line project: Stand studies, composition, growth, mortality, and yield of northern hardwoods.

4. Purpose: To provide the factual information required as to kinds, sizes, and quantities of forest products which will be produced within a given period of time so that forest management can be directed toward maximum value return under sustained yield handling of northern hardwood stands.

5. Review of past work: Fifty-two permanent plots and 114 extensive plots established in Maine, New Hampshire, Vermont, and New York, have all been remeasured once. Records covering 30 years are available for a number of plots. The 1932 survey of the Bartlett Experimental Forest plus some 5,000 cores from 128 plots measured for the Coos-Essex and Tioga cooperative projects provide basic data for growth prediction. A special study of mortality on a large number of the 1932 plots provide data not hitherto available for growth prediction in northern hardwoods. An increment core examining device for field or office use for examining cores by transmitted light has been patented. A system for accumulating mortality and disintegration data has been instituted. Four permanent plots were abandoned because of 1938 hurricane damage, and five others were damaged appreciably.

6. Accomplishments during past year: Data on hurricane damage analyzed. Article on core instrument and coring technic prepared for publication. Technical note on damage by rabbits in hardwoods issued. Article published on photography of permanent sample plots.

7. Plans for next year: Maintenance of all yield plots in second-growth hardwoods will be continued. Report to be prepared on standards for growth prediction in the spruce and northern hardwood regions.

8. Date of completion: Regional growth report and yield tables 1941. Yield study plots to be continued.

9. Assignment: L. H. Reineke.

RS-NE
REGENERATION
Planting
(F-1)

February 1,1941

PLANTING

1. Field division: Forest Management.

2. Work project: Regeneration.

3. Line project: Planting.

4. Purpose: To determine most desirable types of planting and to devise techniques that will improve plantation survival and growth.

5. Review of past work: Regional survey of plantations conducted in 1931 and 1932. Study of relation of method and depth of planting to survival and ultimate development initiated in 1932. Tests of the constancy of racial characteristics under differing environmental conditions were initiated as cooperative effort in 1932, using a single strain of Scotch pine. Establishment of mixed conifer-hardwood plantations was begun with strip mixtures in 1933 and with groupwise arrangements in 1935. Poisoning of undesirable tree growth was tested, with results none too satisfactory. Direct seeding of hardwoods, on sod land, in furrows, seed spots, and on sod showed promise only for sugar maple and red oak. A floristic study of wet areas was made in 1935, with field tests of species and stock for planting such areas. Nursery tests on density of sowing of coniferous seed, begun in 1936, showed value of lighter densities for producing better stock. Outplantings of stock grown at various densities have been made. Experiments were initiated in 1938 in the establishment of rooted and non-rooted cuttings of five clones of hybrid poplars. Deferred planting of hardwoods in the mixed-species plantings were begun in 1939. A test of root-proliferation as an aid to hardwood establishment was made in 1939. Two areas were established for statistically-efficient testing of planting stock with respect to establishment methods, species adaptation, or special treatments under various site conditions. Work on a method of rating the plantability of reforestation sites was started.

6. Accomplishments during past year: Limitation of funds prevented more than the maintenance of going experiments, including the planting of some 24,000 hardwoods and pines in the deferred planting sections of the mixed-species experiments and in refilling gaps in previous plantings. An analysis of the problems of forest planting in the region was prepared.

7. Plans for next year: No new work will be initiated. Routine observations of established plantings will be made, schedule plantings of hardwoods will be made in conifer-hardwood experiments. Results of completed studies will be published.

8. Date of completion: Indefinite

9. Assignment: L. H. Reineke

RS-NE
GENETICS
Field Tests

February 1, 1941

FIELD TESTS -- NEW HYBRID POPLARS

1. Field division: Forest Management.

2. Work project: Forest Genetics

3. Line project: Field tests--Oxford hybrid poplars.

4. Purpose: To determine the adaptability of the Oxford hybrid poplars throughout the United States.

5. Review of past work: Cuttings of 58 selected hybrid clones have been distributed to 25 cooperating Forest Service, Soil Conservation Service, Bureau of Plant Industry, and state nurseries throughout the United States. Preliminary data on nursery behavior have been furnished by cooperators. Field tests of the best hybrids have been started by some of the cooperators.

6. Accomplishments during past year: Ten cuttings of each of the named hybrids were distributed, by request, to government agencies in South America. At the request of the Southern Forest Experiment Station cuttings were forwarded for trial on savannas where the establishment of trees is apparently very difficult.

7. Plans for next year: Completion of the analysis of the data on nursery and field trials which have been submitted to date by cooperators.

8. Date of completion: Final conclusions should be based on data from 10 to 15-year old plantations.

9. Assignment: E. J. Schreiner

RS-NE
GENETICS
Breeding

February 1,1941

BREEDING AND INHERITANCE - FOREST TREES

1. Field division: Forest Management .

2. Work project: Forest Genetics .

3. Line project: Breeding and inheritance .

4. Purpose: Controlled breeding for the production of improved forest trees and for information on inheritance in forest tree species.

5. Review of past work: A total of approximately 2600 seedlings resulting from controlled pollination previous to 1940 on Acer, Betula, Fraxinus, Liriodendron, Magnolia, Ostrya, Pinus, Quercus, and Ulmus are now growing in the nursery at the Hopkins Memorial Forest. Controlled breeding with a number of genera produced non-germinable seed or seedlings which failed to survive. Studies on blooming habit indicate the occurrence of dichogamy in many forest species; failure of controlled self-pollination indicates self-incompatibilities in others. The breeding work with Betula has shown that viable seed of this species may be produced without pollination.

6. Accomplishments during past year: The following seed, matured to controlled pollination was collected in the fall of 1940.

1940 Breeding

Genus	Kind of pollination and number of seeds produced			
	Selfed	Intra-specific	Inter-specific	Total
Acer	424	2,143	1,774	4,341
Betula 1/	100,000	53,000	203,000	356,000
Fagus	54	37	95	186
Liquidambar	6	--	--	6
Liriodendron	172	--	--	172
Picea 1/	3,200	3,000	13,000	19,200
Pinus 2/	90	1,347	2,317	3,754
Quercus	--	12	2	14
Tilia	447	--	--	447
Tsuga 1/	3,450	--	--	3,450
Ulmus	241	--	--	241

1/ Total number of seeds estimated from count on fraction of the total.

2/ Seed matured to 1939 pollinations.

Since Acer saccharinum and A. rubrum mature their seed in late spring, the number of seedlings derived from controlled breeding with these species is available.

Number of Seedlings--Fall of 1940

(Derived from 1940 breeding work)

Genus	Selfed	Intra-specific	Inter-specific	Total
A. saccharinum	9	3	84	96
A. rubrum	--	1689	386	2075

7. Plans for next year: Controlled breeding work will be continued with all important forest genera available in 1941.

8. Date of completion: Controlled breeding will be continued every year.

9. Assignment: E. J. Schreiner, A. G. Snow, Jr., and J. W. Duffield.

February 1,1941

INDIVIDUAL VARIATION

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Variation in percent sugar in the sap of sugar maple.

4. Purpose: To investigate the extent of inherent variation of percent sugar and to discover trees in which percent sugar is consistently high.

5. Review of past work: The early work indicated possible inherent variation in percent sugar in the sap of hard maple. Sugar determinations made with an accurate field saccharimeter during 1939 tended to confirm this conclusion, and indicated that the percent sugar in the sap of individual trees is apparently quite consistent from year to year. Trees growing at the Hopkins Memorial Experimental Forest have shown a variation of from 1 percent to slightly over 4 percent sugar.

6. Accomplishment during past year: Readings were to be taken three times during the day on trees tested in previous years, but unfortunately weather conditions during the sugar season were so bad that a run of sap was obtained on only a comparatively few days during the entire period. The data for this reason are too incomplete for analysis.

7. Plans for next year: The same trees used in the past will be tapped in the spring of 1941 to determine variation in the same individual from year to year and to discover comparatively high producers.

8. Date of completion: Preliminary selection for inherent variation in sugar content will not be possible before 1942 because of insufficient data in 1940. Final conclusions will be based on controlled progeny tests and on tests of selected clones grown on different sites.

9. Assignment: E. J. Schreiner and T. F. Breon

February 1,1941

RACIAL VARIATION

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Seed source investigations.

4. Purpose: To evaluate strains or varieties of native and exotic species on the basis of their forest and use possibilities in the Northeastern region.

5. Review of past work: In 1938 seed of red and white pine from Ontario was distributed to the state nurseries at Saratoga, New York; Amherst, Massachusetts; and Gerrish, New Hampshire. The seedlings are still in the nurseries and are apparently not significantly different from seedlings derived from native seed.

6. Accomplishments during past year: Fourteen seed lots of Norway spruce were planted at the Hopkins Memorial Forest as part of the cooperative tests sponsored by the International Union of Forest Research Organizations. At the end of the first year in the seed bed these seed lots showed highly significant differences not only in percent germination, survival, and average height growth, but also in such qualitative characteristics as color of the needles.

7. Plans for next year: The red and white pine seedlings will be kept under observation, and the 14 lots of Norway spruce growing at Hopkins will be continued in the seed beds for another year.

8. Date of completion: These investigations will be continued from year to year as seeds of important forest species become available.

9. Assignment: E. J. Schreiner and T. F. Breon.

RS-NE
GENETICS
Cytology

February 1, 1941.

CYTOLOGY--CHROMOSOME INVESTIGATIONS WITH FOREST TREES

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Chromosome investigations with forest trees.

4. Purpose: Determination of the chromosome number of species and individual trees used in breeding.

5. Review of past work: Chromosome number in 19 species of Quercus potentially useful for breeding has been determined as 24 in somatic tissue. This added to findings of other investigators indicates that this number is general for the genus and that chromosome number differences will not be a factor in breeding oaks.

6. Accomplishment during past year: The time when reduction divisions occur (information of value in future chromosome investigations) has been determined for many of the numbered breeding trees. The chromosome numbers of several of the maples used in breeding have been found to be in agreement with those previously published. Material of Acer rubrum from several localities throughout its range is being grown to check on the existence of polyploid races within this species.

7. Plans for next year: Routine chromosome number determinations will be continued with emphasis on the genera Betula and Acer in which polyploidy is rather common. Chromosome number determinations will be started on progenies derived from inter-specific crosses in these genera as an aid in verifying hybridity.

8. Date of completion: Chromosome number investigations of parent trees and hybrids will be continued from year to year.

9. Assignment: J. W. Duffield.

RS-NE
GENETICS
Cytology

February 1, 1941

CYTOLOGY--REPRODUCTION IN FOREST TREES

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Cytological aspects of reproduction in forest trees.

4. Purpose: To obtain information on the cytological phases of reproduction essential to research in heredity and variation.

5. Review of past work: This line project has been broadened in scope and includes work reported in 1939 under "Pollen-tube penetration in forest trees." Exploratory work on pollen-tube penetration initiated in 1937 had to be suspended until 1940 because technical personnel was not available.

6. Accomplishments during past year: Pollen-tube penetration problems were not dealt with because breeding work in 1940 was concentrated on genera in which this problem was not considered significant. Chief emphasis has been placed on a study of apomixis (seed production without pollination) in Betula. In B. papyrifera about 2 percent of non-pollinated fruits contained apomictic seed. Cytological studies of the mechanism of apomixis have outlined the chronology of embryo development in B. papyrifera and B. lutea.

7. Plans for next year: The study of apomixis in Betula will be continued and its scope broadened to determine specific and individual variation in degree of apomictic reproduction. The results should constitute a basis for estimating the proportion of presumably hybrid birch seedlings derived from controlled breeding which may in reality be of apomictic origin. Pollen-tube penetration studies will be conducted if the breeding work affords opportunities.

8. Date of completion: The study of apomixis in Betula should be completed within two years. Pollen-tube penetration studies will be continued as problems involving incompatibilities arise.

9. Assignment: J. W. Duffield

RS-NE
GENETICS
Physiology

February 1,1941

PHYSIOLOGY--CLONAL PROPAGATION OF FOREST TREES

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Clonal propagation.

4. Purpose: To develop economically feasible methods for clonal propagation of important forest-tree types.

5. Review of past work: The status sheet covering this work for 1940 was headed "Vegetative Propagation." With optimum auxin treatment the following percentages of rooting have been obtained in outdoor propagating beds:

Sugar maple	80%	White birch	50%
Red maple	70%	Basswood	25%
Aspen hybrids	60%		

The inherent variation in rooting ability of red maple has been found to vary from 18 percent to 98 percent for different individuals.

6. Accomplishments during past year: The following factors were found to influence the rooting of greenwood cuttings of white pine in outdoor propagating beds: (1) age of the tree, (2) position from which cuttings are taken, (3) clonal variation, (4) auxin treatments, (5) types of outdoor propagating beds, (6) length of time in the propagating bed, and (7) possible influence of fungi, (reported in Occasional Paper No.11.) Dormant white pine cuttings planted in outdoor propagating beds did not respond significantly to any particular storage or chemical treatments from the standpoint of rooting, though differences in survival were obtained.

A total of 206 rooted cuttings were obtained from 19 trees representing four species of Acer and 3 species of Betula from which controlled pollinated seed have been obtained.

7. Plans for next year: Study of the possible effects of fungi on white pine rooting, more intensive tests involving types of propagating beds, optimum chemical treatments, and clonal variation, and the continuation of observations on surviving cuttings in the 1940 beds.

8. Date of completion: To be continued until some other agency undertakes adequate work along these lines with species used in the Genetics project.

9. Assignment: A. G. Snow, Jr.

RS-NE
GENETICS
Physiology

February 1,1941

PHYSIOLOGY--REPRODUCTION IN FOREST TREES

1. Field division: Forest Management.

2. Work project: Forest Genetics.

3. Line project: Physiological aspects of reproduction in forest trees.

4. Purpose: To obtain information on the physiological phases of reproduction essential to research in heredity and variation.

5. Review of past work: Suitable storage methods have been developed for white and red pine pollen. This work has shown that germinability may be influenced by humidity treatment just before plating on the germination medium.

6. Accomplishment during past year: Final analysis of the 1939 data indicated that optimum storage conditions for white and red pine pollen are 0° to 4° C. and 50 percent relative humidity. Under these conditions the pollen was still more than 80 percent germinable after 413 days, and thus a major objective-- storage from one growing season to the next-- was attained. Preliminary work on the application of these results to storage of hardwood pollens gave promising results, particularly with pollen of Acer species.

7. Plans for next year: Experiments on storage of hardwood pollens will be initiated. Work with pine pollen will be broadened to explore the possibilities of storage in inert gases.

8. Date of completion: Work with all genera used in breeding will probably not be completed until 1950.

9. Assignment: E. J. Schreiner, A. G. Snow, Jr., and J. W. Duffield.

RS-NE
FIRE
Effects
(Pf-3)

February 1,1941

FOREST FIRE EFFECTS

1. Field division: Forest Management.

2. Work project: Forest Fire Protection.

3. Line project: Forest Fire Effects.

4. Purpose: To study the effect of forest fires upon standing timber, reproduction, and site, and to develop a basis for standardizing methods of appraising fire damage.

5. Review of past work: Investigations, mostly in the oak region have indicated that basal wounding by fire causes delayed mortality and subsequent attack by fungi. Data from 425 plots on 24 fresh burns in Connecticut and New York disclosed the fact that, for the oak region, actual average fire damage appears to be from 1.5 to 4 times greater than fire wardens' estimates. A report on this work was distributed to state forestry agencies. Preliminary laboratory studies of the bark of six common northeastern species indicated that heat resistance of trees is associated with certain morphological and anatomical characteristics.

6. Accomplishments during past year: Although last years' annual report stated that no further work was contemplated on the basal wounding study, work was continued on the heat resistance phase until July when the fire project was closed. Apparatus was developed for determining the rate of heat transmission through bark tissues and tests were run on beech, balsam fir, and hemlock. A distinct difference in heat resistance of the barks of the three species was apparent, the outer bark functioning particularly in this respect. It took, on an average, 13.5 minutes for the inner bark of a 9" hemlock to reach a lethal temperature as against only 5.8 minutes in the case of a 15" balsam fir with bark of almost the same thickness. Beech was less heat resistant than balsam fir.

7. Plans for next year: None

8. Date of completion: Closed July 11, 1940.

RP-NE
TIMBER CONVERSION
Fuelwood Utilization

February 1, 1941

FUELWOOD UTILIZATION

1. Field division: Forest Products.

2. Work project: Timber Harvesting and Conversion.

3. Line project: Fuelwood Utilization.

4. Purpose: To determine possible uses for low grade hardwoods as a source of fuel to the end that waste of such material is minimized and a return may be expected on material removed in silvicultural treatment.

5. Review of past work: Studies initiated in November 1939. Up until the time of the last annual report preliminary work of developing work plans and securing of cooperation of interested agencies had been completed.

6. Accomplishments during past year: (1) The performance of a boiler in a Connecticut state institution using coal as fuel was analyzed. This information is to be used as a basis for comparison if and when it is possible to remodel the firebox and install equipment for stoking and burning hogged wood as fuel at this institution.

(2) A report has been issued on the performance of Char-Wood heaters in actual service. The results showed high efficiency and economy in operation, but changes in design are needed to overcome certain mechanical failures and prevent the emission of smoke and ash into the room when firing.

(3) Time studies of fuelwood production have been made, using various tools, equipment methods and crew organization. New equipment for handling fuelwood in packages has been designed and given preliminary trial. Tests have also been made to determine the cost of hogging wood which has been cut into sticks of varying length.

(4) The possible use of wood gas by state institutions was explored. The results were negative in that it appeared that wood fuel would have to be delivered for about $4.20 per cord to compete with coal for this purpose.

(5) After some preliminary work a portable charcoal kiln has been built and tested. Satisfactory yields have been obtained and valuable information on draft control has been developed.

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7. Plans for next year: Continue attempts to secure satisfactory equipment for stoking and burning hogged wood. To further study hogged wood production and transportation problems. Continue the development and testing of equipment and methods of fuelwood production. Continue work on the development of portable charcoal kilns. Make studies of seasoning of fuelwood.

8. Date of completion: Indefinite.

9. Assignment: Allen W. Bratton in cooperation with state agencies in Connecticut.

February 1,1941

FORES T SURVEY

1. Field division: Forest Survey.

2. Work project: Survey of Forest Resources.

3. Line project: Inventory: Cooperative technical supervision of an inventory of forest resources in southwestern Maine.

4. Purpose: To insure adequacy of field methods in the CCC type map and inventory of the white pine region of southwestern Maine, and to determine the most desirable technique for inventorying the entire northeast.

5. Review of past work: In 1936, twelve enrollees and a foreman at each of four CCC Camps in southwestern Maine began a type map and inventory of forest resources in accordance with plans for field and office work prepared by the Northeastern Station. Initial training of field crews was supervised by the Station and technical guidance was provided during the course of the work. One CCC camp was discontinued in 1937, but the crews in the remaining three camps were doubled. Side camps were established as needed to facilitate the survey. Eighty towns (one incomplete) aggregating 1,898,480 acres were covered by the crews in 1936, 1937, and 1938, at an intensity of 0.25 percent for inventory and 0.50 percent for type mapping. Field work was discontinued in 1939 because of the demands of insect control work. Type maps showing types according to the Society of American Foresters' classification have been completed for area covered by the survey, and a substantial portion of the inventory computations have been made.

6. Accomplishments during past year: Field work was not resumed during 1940. Organization of records pending use for guidance of the national survey was begun, and information useful for planning silvicultural control of gypsy moth was extracted. Article prepared presenting a legend covering the 96 forest cover types recognized by the Society of American Foresters for the eastern United States.

7. Plans for next year: If type mapping is resumed, the inventory phase will be reduced to the intensity which will be required for region-wide survey. Report to be issued on results of survey to date.

8. Date of completion: 1941.

9. Assignment: L. H. Reineke.

RI-NE
STREAMFLOW

February 1, 1941

STREAMFLOW ON FORESTED WATERSHEDS

1. Field division: Forest Influences.

2. Work project: Water Behavior and Run-off.

3. Line project: Relation of forest and herbaceous cover to streamflow.

4. Purpose: To study the streamflow on small forested watersheds and the effect of changes in vegetative cover and land use practices.

5. Review of past work: At the Chenango Experimental Forest, a weir and stream-gauging station with two ground water measuring wells have been in operation since 1938. Four additional measuring wells were added in 1939, and a silting basin was constructed above the weir. Discharge measurements were made during low water stages for obtaining weir ratings. At the Hopkins Memorial Experimental Forest two weirs have been in operation since 1939 and construction has been under way on three additional installations.

6. Accomplishments during past year: At the Chenango Forest, four additional ground water measuring wells were constructed and the stream channel below the weir was straightened and prepared for rating by current meters. Hydrologic and snow measurements were made throughout the year. At Hopkins records were obtained on two weirs. The channel above one of the incompleted weirs (#1) was improved by replacing a road culvert with a bridge and cutting through an old dam basin.

7. Plans for next year: Hydrologic and climatological measurements will be made at Chenango during the periods of occupancy and the weir will be rated by representatives of the Flood Control Survey. At Hopkins, climatological records will be continued and hydrologic data obtained at completed weirs. Installation of Columbus type weir at fifth location depends on availability of plans and CCC labor. Cleaning and straightening of stream bed above weir #1 to be completed.

8. Date of completion: Indefinite.

9. Assignment: R. F. Taylor.

RM-1.E
FOREST COOPERATIVES
Cooperstown

February 1,1941

COOPERATIVE MANAGEMENT AND MARKETING FOR FARM WOODLANDS

1. Field division: Forest Ecomomics.

2. Work project: Forest Cooperatives.

3. Line project: Cooperative management and marketing for farm woodlands.

4. Purpose of work: To establish the technical basis for cooperative management and utilization of farm woodlands in order to rebuild depleted growing stocks, restore and stabilize local forest industries, and afford woodland owners regular and more adequate income.

5. Review of past work: Although incorporated in December,1935, the Otsego Forest Products Cooperative Association did its first business with members in the fall of 1937. Prior to 1940, while the main processing plant was under construction, more than 100 members delivered logs to the Association, and about 800 M bd.ft. of lumber were manufactured in a temporary mill set-up.

During this period the Station has studied all developments in order to gain information on the various technical and psychological problems involved. In the woods a rapid system of forestry control and a supplemental system of stump cruising to check cutting have been developed. The Station has assisted in planning for the new processing plant. It has assisted in the establishment of standards of forestry practice and of log grades. Studies of log making, skidding, and truck hauling, and certain milling operations have been made. An accounting system especially adapted to the needs of a forest cooperative has been devised. More generalized studies dealing with the place of woodlands in the rural economic structure were carried on. Furthermore, the staff has supervised loans made to the Association by the Farm Security Administration.

6. Accomplishments during past year: An intensive campaign during the summer and fall raised the membership to 640. The Station assisted in the educational work by supplying basic information, colored lantern slides, and fair exhibits, and by supplying speakers for numerous group meetings. It also contributed to "The Otsego Cooperator" - a monthly publication inaugurated by the Association during the summer.

The Station continued its service of inventory and marking of timber for members, covering woodland of about 200 farms and marking 2 million bd.ft. of timber for cutting. Guides to desirable growing stock have been added to methodology for handling this work.

During the year, while completing plantfacilities and "tuning up" the mill, over 1 million bd.ft. of logs were sawn and 800 M bd.ft. of lumber and small dimension stock were sold. The mill crew, largely recruited locally, was trained to a point where an anticipated production of 17 M bd.ft. per day was attained. Of especial significance in the marketing field was the increase in proportion of lumber sold back to members. This development was facilitated by installation of a new high-speed moulder and by construction of a new consumer's yard for storage of softwood lumber.

Announcement of specifications for hardwood bolts did not bring many deliveries. Apparently operating methods cannot be easily adjusted to handle both logs and bolts on small farm jobs. An experimental venture in the cutting and marketing of pulpwood did not turn out satisfactorily, due primarily to shortage of labor.

To meet demands for service in a wider area than could be economically served by the main plant, a "feeder mill" was established about 30 miles away. A portable mill, operating under contract, has been set up to saw logs delivered by members in that vicinity.

During the summer a work camp of graduate students was established at Cooperstown by the American Friends Service Committee. This group aided in construction of a yard on wheels for the Association, participated in the cruising and marking work, and assisted the Station in production cost analyses. During the fall the camp was put on a year long basis as the first unit in the program of Civilian Public Service authorized by the Selective Service Act.

Early in the year analyses of operating prospects for the Association were made by experts from both the Forest Service and the Farm Security Administration. Following this a supplemental loan of $84,000 was negotiated by the Association. During the summer, auditors from the F.S.A. made a thorough check of the Association's business during the fiscal year ending June 30,1940. In October sole responsibility for administration of government loans was delegated to the Forest Service. A loan administrator was appointed to handle the details of current fiscal control and to aid the Association in development of its operations.

7. Plans for next year: Close and active cooperation with the Association to maintain the flow of logs, reduce costs in operation, and strengthen over-all business management will absorb most of the time during 1941. This will doubtless entail numerous analyses of milling costs, grade recovery, and yield in dimension manufacture. Beyond this, in connection with current activities, it is planned to make a complete analysis of as many cutting areas as possible to gauge effectiveness of the present educational work and silvicultural control. In cooperation with the Bureau of Agricultural Economics, which will assign a man to Cooperstown for six months, studies will be made of farm management in all its aspects, on a number of farms which have participated in the cooperative forestry program of the Association. A report on the system for forest inventory and growing stock control which has been developed on this project will be published.

8. Date of completion: Indefinite

9. Assignment: C. R. Lockard, D. Rulison, and J. Rude.

R-NE
FARM FORESTRY
New York

February 1,1941

FARM CONSUMPTION AND OUTLETS FOR FARM FOREST PRODUCTS

1. Field division: Forest Economics.

2. Work project: Financial Aspects.

3. Line project: Farm Forestry - Farm Consumption and Outlets.

4. Purpose of work: (a) to determine for a given economic unit the use made of farm woodlands by operating farmers and the factors influencing that use, the results to be used as a basis for cooperative forest management in similar units; (b) to develop methods necessary for carrying on similar studies elsewhere.

5. Review of past work: This work was initiated in 1940.

6. Accomplishments during past year: Under policies established by the Memorandum of Understanding between the Forest Service, the New York State Agricultural Experiment Station, the New York State College of Forestry and the New York Conservation Department, the Northeastern Forest Experiment Station has directed the work on this project. Initial attention was given to analysis of the home use of forest products within a unit comprising all of four and parts of two towns in the white pine region of New York State. Data were collected on all of the 444 operated farms within the selected unit. A random sample of 51 hill farms and 60 valley farms was then studied intensively with respect to general economic status and data on the use and sale of forest products were gathered. Incidental to this work much information was obtained on distribution of land ownership within the area. In addition, data were obtained on 112 forest products markets available to producers in the unit. Analysis of the data collected required development of some new procedures for such problems as estimating the use of wood in farm buildings. A report of findings was distributed to the cooperating agencies in December.

7. Plans for next year: The available funds will be exhausted about the first of April. Prior to that time the field work will be extended to include an area in Clinton County in order to give wider significance to the

final report. Information on log buying methods obtained in connection with this project will be used for an Occasional Paper.

8. Date of completion: April 1,1941

9. Assignment: C. R. Lockard and R. D. Carpenter.